Assessing and Addressing Lead Exposure in New York City Community Gardens through a Community-Research Partnership

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PEPH Urban Gardening Webinar, May 26, 2016
Urban community garden benefits

- Increasing consumption of fresh fruits and vegetables
- Exercise, contact with nature
- Social Interaction (inter-generational, cross-cultural)
- Neighborhood revitalization
- Urban green space, reduced urban heat island effect
- Less need to transport food from distant farms

US community gardening households
(National Gardening Association)
NYC Community Garden History

- 1970s financial crisis, abandoned buildings, vacant lots
- Green Guerillas threw "seed bombs“ (seeds & fertilizer) over fences into vacant lots
Genesis of a NYC Garden
GreenThumb

by the Numbers

An estimated 87,000 pounds of edible food is produced in GreenThumb gardens each year.

More than 150 workshops are given by GreenThumb each year.

Over 1,000 tons of soil and compost are delivered to gardens each year.

There are more than 2.8 million square feet of garden space in the five boroughs.

More than 100 rain water systems are installed in GreenThumb gardens, collecting more than 1.1 million gallons of water each year.

Oversees and provides services to 600 community gardens

GreenThumb
The largest community gardening program in the nation
Urban soils & contamination

- Early community based organization testing
- Many gardeners aware of potential for soil contamination
- Common adoption of raised bed gardening

RAISED BEDS

If soil tests indicate that the soil contains elevated contaminant levels, building a raised bed will allow you to garden safely. It is important that the soil being brought in is from a source known to be free of contamination. Raised beds are also beneficial because they lengthen the growing season by warming up sooner in the spring than a traditional garden. Do not build the beds using chemically treated lumber or railroad ties. See the publication “Raised Bed Gardens” listed in the resources section for more details on these gardens.
Gardener questions

- Should I test my soil? Location? Site history?
- How do I collect soil samples? How many? From where?
- Where should I send the samples? Analytical method? Cost? Certification?
- What do the results mean? Standards? Background levels? Plant uptake? Human health?
- What should I do? Best practices? Strategies to reduce exposure?

Other unknowns

- What is the extent of contamination?
- Is it a public health concern?
Healthy Soils, Healthy Communities

Goal: To help community gardeners and other community partners make informed decisions about soil contaminants

GreenThumb / New York City Department of Parks and Recreation
Carlos Martinez, Bill LoSasso, Ijendu Obasi, Nancy Kohn, Edie Stone, and colleagues

Cornell University Soil and Crop Sciences, and Cornell Waste Management Institute
Murray McBride, Hannah Shayler, Jonathan Russell-Anelli, and colleagues

Cornell University Cooperative Extension-New York City
Gretchen Ferenz and colleagues

New York State Department of Health
Henry Spliethoff, Lydia Marquez-Bravo, Rebecca Mitchell, and colleagues

NIEHS PEPH Research to Action
Additional Community Partners

- BOLT
- NYC CGC
- NYRP
- JUST FOOD
- Brooklyn Botanic Garden
- Grow NYC
- BLACK URBAN GROWERS
- Sustainable Flatbush
- Urban Garden Connections
- Earth Matter
- Brooklyn College
Lead study community gardens
Community partners, gardeners and others provided invaluable help by providing access and/or collecting samples for contaminant analysis.
Lead in Soil

- 90% of bed samples <400 mg/kg (NYS residential Soil Cleanup Objective (SCO))
- 44% of gardens had at least one soil sample >400 mg/kg.
- Concentrations reached as high as 2450 mg/kg.

Garden Soil Pb Concentrations (from 54 gardens)

Context of Potential Exposures to Lead in Community Gardens

- Gardens located in neighborhoods historically burdened with elevated children’s blood lead levels due to deteriorated housing, etc.
- Children visit many gardens
Lead in Vegetables

- Levels (83% > 0.01 mg/kg, n=159) higher than US FDA market basket vegetables (95% < 0.01 mg/kg, n=1,472). Some samples > European vegetable lead standards.
- Not related to soil lead levels, but a function of vegetable type

Lead in Eggs

Nearly all < European lead standards

Multipathway Lead Exposure Assessment

<table>
<thead>
<tr>
<th>Pb Source</th>
<th>Adult gardener</th>
<th>Child visitor</th>
<th>Adult household member</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed soil</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-bed soil</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Tracked non-bed soil in house dust</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Produce</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Soil adhered to produce</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Eggs</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

[Image of an outdoor area with tire swings and a dirt path with various objects scattered around.]
Multipathway Lead Intake

- All central tendency intakes below USFDA’s Provisional Tolerable Total Intake (PTTI)
- Exposure from eggs very small
- Most children’s exposure from ingestion of soil & dust
- Most adults’ exposure from consuming vegetables (~45% from adhered particles)

- Putting clean soil in beds - e.g., raised beds - may not reduce most significant exposures.
Multipathway Lead Intake

A percentage of children and gardeners exceed PTTI.
Implications for Exposure Reduction Strategies

Continued efforts to reduce exposure are warranted. Adding clean soil and amendments to beds is important, but:

- Children’s exposure may be most effectively reduced by minimizing soil direct contact and tracking (e.g., between beds and other places children play).
- For pregnant women, focus should be on growing/eating fruiting vegetables over leafy and root vegetables.
Actions

- **Education, outreach and community engagement**
- **Ongoing clean soil distribution to gardens**
- **Ongoing collaboration**

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

1. Use clean soil and compost. 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 burlap 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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**Healthy Gardening**

Tips for New and Experienced Gardeners

- **Use clean soil** when constructing new garden beds. Consider having the soil tested by a NYS-certified laboratory.
- **Limit foraging activity to areas where soil is not suspected to have higher concentrations of lead or other chemicals.**
- **Remove** plants and foraging areas. Some items can harm chickens if they are eaten, and some may also be a source of lead or other chemicals.
- **Don’t feed chickens unweathed plant material** from areas of your garden where soil has higher concentrations of lead or other chemicals.
- **Provide a calcium supplement.** An adequate calcium supply is important for laying hens, and it may help reduce the amount of lead that gets into their eggs.

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**Healthy Soils, Healthy Communities**

**Metals in Urban Garden Soils**

Metals are naturally present in rock, soil, and other materials. They are also used in manufacturing (catalytic converters, metals, and paints) and in human activity can increase the levels of metals in soil. Urban soils often have higher levels of metals than rural soils because they have been affected by human activity. Gardening in urban soils may increase your exposure to metals if you grow food or booster soil gardeners or soil food raised on or in the soil.

What metals can be traced in urban gardens?

The table on this page lists several common metals found in urban garden soils, along with guidance values developed to protect human health. See the table for guidance values.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Exposure Value Protection of Public Health</th>
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<tbody>
<tr>
<td>Arsenic</td>
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<tr>
<td>Barium</td>
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<tr>
<td>Cadmium</td>
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<tr>
<td>Chromium</td>
<td>56.0</td>
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<tr>
<td>Copper</td>
<td>15.0</td>
</tr>
<tr>
<td>Lead</td>
<td>60.0</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.01</td>
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</tbody>
</table>
Thank you

We greatly appreciate the support of gardeners and our other collaborators.

Analytical laboratory support: NYS Ag & Markets Division of Food Lab, Cornell Nutrient Analysis Laboratory, NYSDOH Wadsworth Center, Pace Analytical & H2M.

The project described is supported by Award Number R21ES017921 from the National Institute of Environmental Health Sciences (NIEHS). The content is solely the responsibility of the authors and does not necessarily represent the official views of NIEHS or the National Institutes of Health.