ADDRESSING ENVIRONMENTAL HEALTH ISSUES FACING BOSTON-AREA GARDENERS

USING SCIENCE AND PARTNERSHIPS TO GUIDE RISK MANAGEMENT

PRESENTED BY W. HEIGER-BERNAYS
BU SRP RESEARCH TRANSLATION CORE
MAKING PROGRESS
ZONING FOR GROWING

“Urban agriculture improves access to fresh, healthy, affordable food, with decreased transportation costs and lower carbon emissions.”

http://www.cityofboston.gov/food/urbanag/

Gardening and Farming – Is the difference the size of the plot?

Urban Agriculture Zoning – Boston Article 89
• Ground-Level Farms – based on their size and location.
• Roof-Level Farms
• Freight Container Growing

• Animals
  • Hens
  • Bees
  • Goats
GARDENING **RISKS** AND **BENEFITS**

- Historical Contamination
- On-going Contamination
- Contaminated Soils

- Fresh Produce
- Food Security
- Physical Activity & Skills
- Community Building
- Water filtration & Less Erosion
- Property values
- Local Economy

Gardening
COMMUNITY VS BACKYARD GARDENS
GARDENS AND FARMS

Boston Community Gardens

“Backyard” Gardens
### Conceptual Model of Exposure for Contaminated Soil & Compost

<table>
<thead>
<tr>
<th>Contaminant Sources</th>
<th>Exposure Media</th>
<th>Activities</th>
<th>Exposure Pathways</th>
<th>Population Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint</td>
<td>Soil</td>
<td>Digging, Working Soil</td>
<td>Dermal contact</td>
<td>GARDENER (Adult &amp; Child)</td>
</tr>
<tr>
<td>Treated Lumber</td>
<td></td>
<td></td>
<td>Inhalation of particulates</td>
<td></td>
</tr>
<tr>
<td>Pesticides</td>
<td>Compost</td>
<td>Consumption of garden produce</td>
<td>Incidental Ingestion</td>
<td></td>
</tr>
<tr>
<td>Burned Trash</td>
<td></td>
<td>Contact transfer*</td>
<td>Ingestion of garden produced</td>
<td>CONSUMER of garden produce (Adult &amp; Child)</td>
</tr>
<tr>
<td>Asphalt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street Sweepings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food Waste</td>
<td>Garden-grown Produce via uptake</td>
<td>* to clothing, shoes, gardening tools, bed dividers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HUMAN SOIL EXPOSURES
DIRECT AND INDIRECT

Ingestion of Soils
Inhalation of Dust

Uptake into Plants
Deposition on Plants
<table>
<thead>
<tr>
<th>Common Sources</th>
<th>Concentration Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td></td>
</tr>
<tr>
<td>Paint on Houses (pre 1978)</td>
<td>400 - &gt; 2000 mg/kg(^1)</td>
</tr>
<tr>
<td>Leaded Gasoline</td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td></td>
</tr>
<tr>
<td>Pressure Treated Lumber (CCA)</td>
<td>0.1 – 99 mg/kg(^2)</td>
</tr>
<tr>
<td>Pesticides (Pb.arsenate)</td>
<td></td>
</tr>
<tr>
<td>Total PAHs; n=16</td>
<td></td>
</tr>
<tr>
<td>Burned Trash or Coal</td>
<td>2.2 – 167 mg/kg(^3)</td>
</tr>
<tr>
<td>Street Sweepings</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)USEPA, Lead Safe Yards Program (2001).
\(^2\)MassDEP, (2002). Technical Update: Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil
ON-GOING CONTAMINATION

Cat Poop – biological Hazard (Toxoplasmosis)

On-going Use of Chemical Pesticides (Labeled & Unlabeled)

Responses to Boston-Area Garden Survey

- Problem with pests at the garden site: 64%
- Any use of pesticides at the garden site: 68%
- Not prepared to recommend APM: 50%
- Not prepared to discuss/answer questions: 29%
- Not prepared to discuss/answer questions: 18%
GOOD GARDENING PRACTICES

- Wear gloves while gardening
- Wash hands before eating
- Wash and scrub vegetables before cooking and/or eating
- Leave shoes outdoors or at the door so as not to track excessive dirt inside
- Try not to let children eat soil

Developed to protect people from exposures to contaminants in urban soils

But realistic? Are these practiced?
COMMUNITY CONCERNS
INFORMAL CONVERSATIONS

• Gardens will become re-contaminated so why bother raising beds and adding clean soil?
  • Recontamination of the upper micro-layer may occur, but this can be decreased by covering bare soil around the beds with mulch, straw, stone.

• We’ve heard that breathing the lead contaminated soil in the garden is just as important as ingestion.
  • Pilot studies of simulated garden activity have measured negligible, if detectable PM/lead.

• What happens if we don’t wear gloves?
  Pilot studies on-going using hand-wipes to try to answer this question with data.
### Boston Children Engaged in Gardening

**Schools, camps and community gardens**

**Frequency? Glove Wearing? Hand Washing?**

<table>
<thead>
<tr>
<th>Age Group (Years Old)</th>
<th>Number of Children</th>
<th>% of Children</th>
<th>Hours Per Day</th>
<th>Days Per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 6</td>
<td>402</td>
<td>26.8%</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>7 to 12</td>
<td>917</td>
<td>61.2%</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>13 to 18</td>
<td>180</td>
<td>12.0%</td>
<td>2.6</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Parikh, B., DiPerna, A., Wyner, Z., Heiger-Bernays, W. Manuscript in Preparation
GARDEN PLANNING & MAINTENANCE

1. Budget
2. Historical review (multi-source)
3. Gardener Preferences
4. **Sources of loam & compost**
5. WATER SOURCE

*Build raised beds, cover old soil with [geotextile cap] and import soil for planting*

*Best Management Plans (BMPs)*
BOSTON MUNICIPAL COMPOST IMPROVES IN QUALITY (2006-2015)

Annual Testing – Delivery to Gardens

Massachusetts BANS FOOD WASTE
**LEAD (MG/KG) IN MULTIPLE COMPOSTS**

**NOT EQUIVALENT BIOAVAILABILITY**

<table>
<thead>
<tr>
<th>Lead (mg/kg) Measured in Multiple Compost Sources</th>
<th>Boston City</th>
<th>Source A</th>
<th>Source B</th>
<th>Source C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compost (mg/kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>3</td>
<td>24</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Mean</td>
<td>220</td>
<td>283</td>
<td>92</td>
<td>122</td>
</tr>
<tr>
<td>SD</td>
<td></td>
<td>20</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Median</td>
<td>220</td>
<td>277</td>
<td>87</td>
<td>113</td>
</tr>
<tr>
<td>Maximum</td>
<td>240</td>
<td>413</td>
<td>134</td>
<td>198</td>
</tr>
<tr>
<td>Minimum</td>
<td>200</td>
<td>192</td>
<td>57</td>
<td>83</td>
</tr>
</tbody>
</table>

Source A; farm waste
Source B; unknown
Source C; food waste

HOW ABOUT THE LOAM?
WHERE ARE THE KNOWLEDGE GAPS?
LEARNING FROM OUR PARTNERS

Risks

• Assume that young children are always in the garden; Good Assumption?

• Assume 60-100% bioavailability; NEED VALIDATED, INEXPENSIVE METHODS

• No requirement for testing of incoming soils/composts

Commercial farms are NOT held to same standards as urban gardens/farms
SHOULD I CONTINUE GARDENING?
YES, YES, YES

- Follow Best Management Practices to start the garden;
- Learn what’s in your “clean” loam and composts;
- Develop meaningful approaches to deal with chemical pesticide use;
- Do not leave food/water for cats;
- Wash your hands!
LEARNING FROM OUR PARTNERS
NEW CHALLENGES & OPPORTUNITIES

Gardener to Gardener
Backyard Gardening
Biochar?

Healthy Housing –
Includes food gardens
Elder housing
Public housing

WATER COLLECTED FROM STORM SEWER
ACKNOWLEDGEMENTS

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Trustees of the Reservations, formally Boston Natural Areas Network
Valerie Burns & Jeremy Dick

Food Corp (US Americorp)
The Food Project, Boston

Boston Community Gardeners

http://sites.bu.edu/sciencegardenercollaborative/
SRP # P42 ES007381
ADDITIONAL RESOURCES


• Healthy Gardening in Urban, Brownfields and Superfund gardens