Soil Issues in Urban Farming

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Topics

- Soil quality
- Soil testing
- Risks posed to urban farmers/consumers
  - high levels of lead
- Ways to mitigate –
  - in-ground
  - raised bed farming
  - greenhouse/container production
Soil Quality

- The capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to
  - sustain plant and animal productivity,
  - maintain or enhance water and air quality, and
  - support human health and habitation

(Karlen et al. 1997)

- “Soil Health” - Analogy to health of an organism: implies assessment of multiple internal, interdependent systems

- Soil Security –
  - Goal of Soil Sustainability
  - Strategy: regaining balance in
    - organic C inputs and losses,
    - soil erosion and production, and
    - release and loss of nutrients.

Ronald Amundson et al. 2015.

Soil Testing

- Soil properties measurements to assess soil quality
  - Select appropriate indicators for the specific soil use
  - Compare values between sites, or over time
  - More properties quantified, better evaluation
  - Determine best practices to manage properly
  - Grid sampling may be necessary to determine variability (esp. find “hotspots”)

- Soil pH, nutrient content, organic matter
- Soil texture, density, drainage/aeration
- Soil food web components
- Absence of pollutants/toxins
Potential Hazards or Issues specific to Urban Landscapes

- Soils in urban areas are usually highly disturbed
  - Anthropogenic
  - Topsoil removed, inverted
  - Eroded
  - Lack of fertility
  - Compacted surface and subsoil
  - Dry, Hot when not irrigated.
  - Or excess water with stormwater runoff
  - Polluted
    - Asphalt, concrete
    - Lead (historical use)
    - Local manufacturing “fallout”
    - Dumping – garbage, construction debris, chemicals

Examples

**Laguardia** soil series profile - artifacts in multiple deposits of human-transported material. The buried building debris contains brick, concrete, wire, steel, and asphalt. *(Photo by Richard Shaw)*

**Ladyliberty** soil series profile - transported topsoil (0 - 16 cm), over transported coal slag with artifacts, over dredged spoil deposit (55 cm), overlying naturally deposited, gleyed substratum (120 cm). *(Photo by Richard Shaw)*
Restoring Degraded Soil

- De-Compact
  - Tillage or other physical manipulation
  - Organic matter
  - Re-populate soil organisms – including roots
- Amend with Organic Matter (re-creating topsoil)
  - Compost
  - Primary Producers (plants! Including cover crops)
  - Mulch
  - Inoculate?
- Adjust pH, Balance nutrients

Climatic forces and organisms are the major actors in soil development

Mitigation of Lead

- Rutgers Cooperative Extension publications
  - E 342 - Safe Soil: A Healthier Way to Garden (available in English and Spanish)
  - FS 336 – Lead Contaminated Soil: Minimizing Health Risks
- Test to determine levels across the site; watch out for hotspots!
- Maintain soil pH of 6.5 to 7.0 to help minimize absorption of lead by plants
- Where lead level is above background,
  - Grow only flowers/ornamental plants.
  - Root crops: most likely to contain any absorbed lead (internal) plus adsorbed lead (external soil)
  - Leafy or stalk vegetables next-most likely to have elevated lead from soil uptake.
  - Vegetables that pose lowest risk: fruiting crops
- Wash vegetables carefully to remove soil and dust deposits, peel all root crops.
- Wear gloves to minimize exposure.
- Cover any bare soil, prevent dust generation
  - Sod - immediate grass cover plus thin layer of new soil at the surface
  - Other: woodchips, mulch, or clean sand
- Prevent Indoor Contact with Lead
  - Avoid transporting soil into the house on shoes, clothing, gloves
  - Frequent vacuuming or mopping, regular cleaning of all surfaces
Raised Beds

- Use wood, stone, brick, plastic etc. to construct the sides of the production beds
  - Note concerns with wood preservatives
  - Concrete can contribute to alkalinity of soil
- Constructed bed should be at least 1 ft deep and 3 - 4 ft wide
- Line with landscape fabric, cheese cloth, or other fabric - must allow good drainage.
- Fill the container with clean soil
  - Mineral soil preferred for more natural and sustainable situation
  - Potting mix/bagged/“organic” “topsoil”? 
    - Similar problems of containerized plants
    - Organic matter continues to break down, loses structure
      - Compacts, holds excess water, reduces aeration, promotes pathogens
      - Too much soil respiration? And oxygen scavenging
      - Plant nutrition
    - Lightweight, floats/erodes
    - Hydrophobic when dry

Growing Media for Containers

- Allows plants to be grown where otherwise not feasible and/or to be moved around (lightweight containers)
  - Indoors; on hardscape
  - Poor soil conditions – compacted, rocky, contaminated
- Not low maintenance
  - Irrigation, fertilizer, specialized equipment
  - Knowledge/understanding of plants being grown, “soil”, and other environmental conditions (humidity, temperature) necessary
- Rutgers Cooperative Extension Fact Sheets
  - Fundamentals of Container Media Management: Part I
  - Fundamentals of Container Media Management, Part 2, Measuring Physical Properties
  - Monitoring and Managing Soluble Salts in Ornamental Plant Production
Greenhouse growing media
AKA “Potting soil”
- Components:
  - Primarily organic matter
  - Peat moss
  - Bark or wood chips
  - Coconut coir
  - Compost (< 25% volume)
  - Sand, gravel, rarely mineral soil (< 1/3 volume)
  - Perlite (expanded glass), vermiculite (expanded mica), or pumice (porous volcanic rock)
- Physical properties critical: water-holding capacity (2x-4x volume), drainage/aeration, limited volume
- Chemical properties: cation exchange capacity
  - Plant nutrients “spoon-fed” with fertilizer

Water Management in pots/containers
- Depth of container is critical
- Water accumulation at bottom

http://lieth.ucdavis.edu/research/tens/98/smtpub.htm
Salt Accumulation in pots

- Ions added to container soils can accumulate to cause osmotic stress or “burn” plant tissue
  - Fertilizers
  - Irrigation Water
  - Compost
- Evaporation of water allows salts to precipitate (crystallize) from solution
- Leach with excess water
- Do not water from below

Other notes about container soils

- Limited rooting volume (esp. perennials)
  - Transplanting/re-potting necessary with increasing size
- Subsidence of organic matter (volume reduction)
  - Additional volume of “soil” needed when re-potting
- Temperature effect – less moderation than in natural (in-ground) soils
  - Hotter/Colder/Variation – root metabolism suffers
  - Effects of water temperature, container color
- Biology – very limited food web; organisms other than plants generally are not desired
- High level of management required:
  - Pest control
  - Lighting amount/quality
  - Irrigation, Fertilizers
  - Temperature control
  - Air circulation, humidity
Conclusions

- Urban soils are often very disturbed and have poor soil quality for plant production, but variability is high.
- Soil testing is necessary to determine agronomic management factors and environmental risks.
- Remediation of poor-quality soil is initiated with de-compaction and/or organic matter amendment, as well as fertilizer and limestone if indicated by soil test.
- Contamination issues may prevent use of in situ soil.
- Raised bed option: minimum of 12” mineral-based soil is recommended.
- Container plantings with artificial growing media – high management level.