

The State of Scientific Knowledge and Research Needs

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Steve Rock

US EPA

5995 Center Hill Ave.

Cincinnati, OH 45224

513-569-7149

rock.steven@epa.gov

Dr. Kirk Scheckel

US EPA

5995 Center Hill Ave.

Cincinnati, OH 45224

513-487-2865

scheckel.kirk@epa.gov

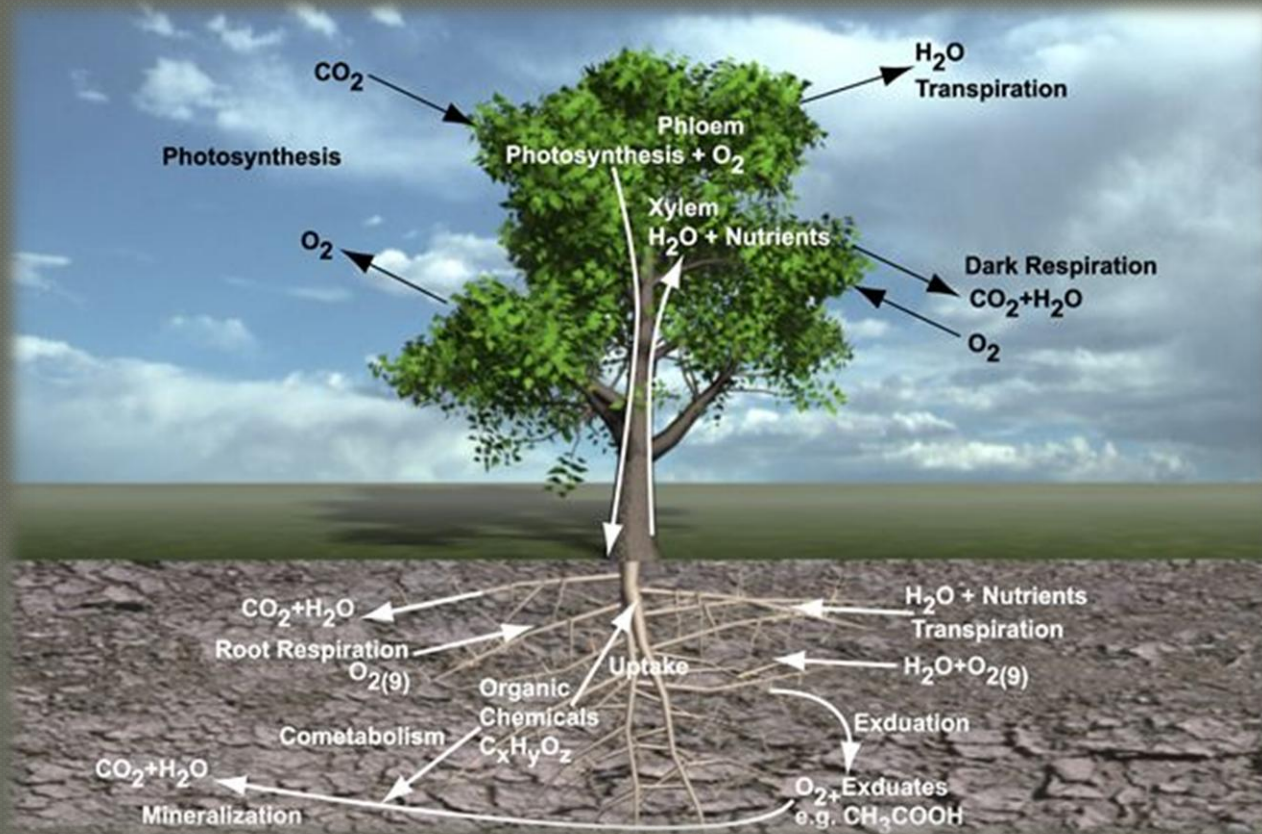


Narrowing the focus

1. Plants, Soil, and Contaminants
2. Phyto Applications for Urban Soil
 - Metals
 - Chlorinated Solvents
 - Pesticides

Plant Relationships

- Plants influence and are influenced by air, water, and soil in complicated ways.



Plants and Urban Soil

Two mechanisms:

- **Phytoremediation**

- Plants help break down organic material including organic contaminants

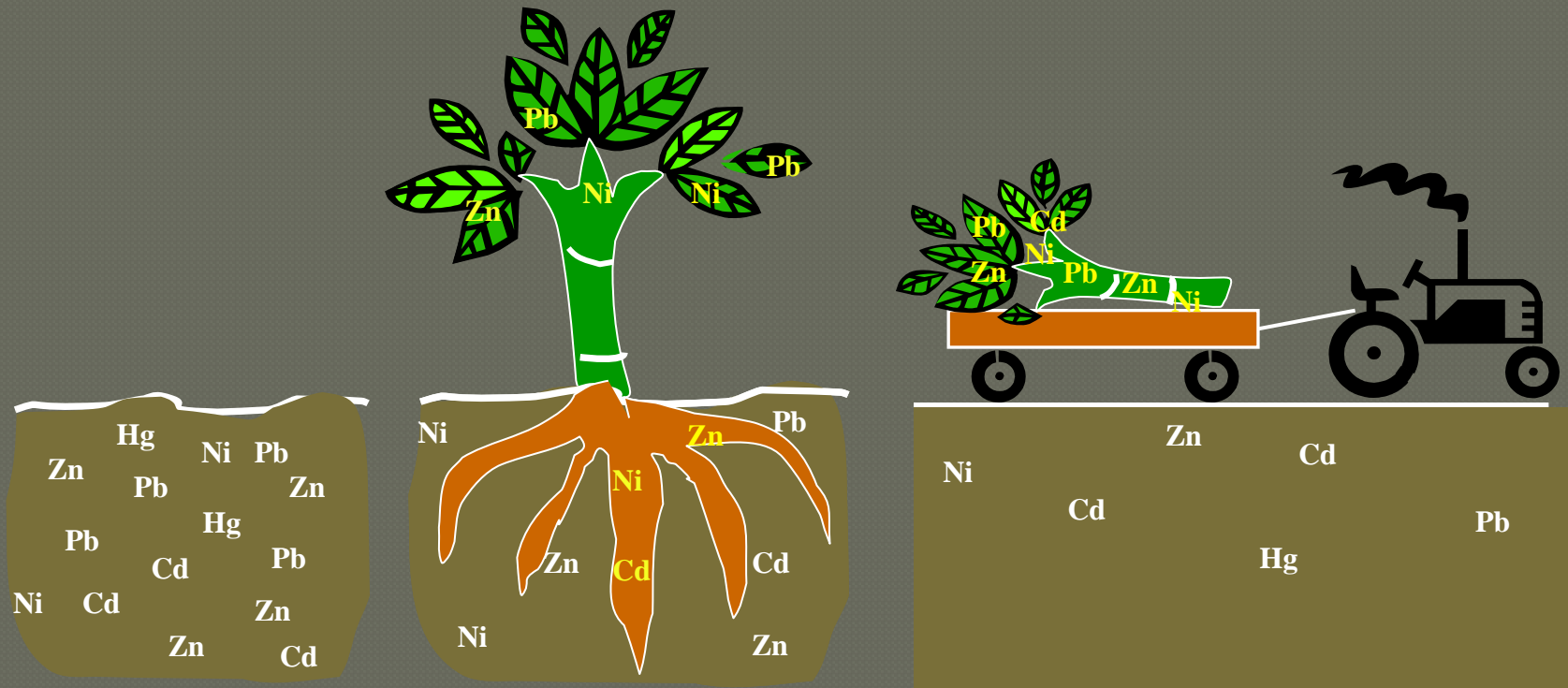
- **Phytoextraction**

- Very rarely plants bioaccumulate metals in above-ground tissue than in soil

Phytoextraction

- Most Urban soils have metal
- Metals cannot be degraded
- Metals do not move easily in soil
- Metals do not move easily into plants
- Metals can shift to more or less bioavailable forms

Phytoextraction of metals from contaminated soil



Lead

- Several well known studies suggest that lead may be cleaned from soil by sunflowers or mustard plants- these studies are not field verified
- Natural Hyperaccumulators not been found
- Chemical enhancement is needed to mobilize – expensive and unreliable

Cadmium and Zinc

- Cd extraction is prohibitively slow, except perhaps with low concentrations
- Zn is phytotoxic in high concentrations and extraction is slow
- Cr lacks a hyperaccumulator, low extraction potential due to insolubility

Chemical enhanced

- Can mobilize and solubilize Pb, Cd, Cu, Ni, and Zn
- Chelators: EDTA, citric acid, HEDTA, EGTA, DTPA, E
- Environmentally risky – may mobilize metals into ground and surface water
- Poor performance in field studies
- Expensive

Nickel – the case for natural extraction

- Of the 400 natural metal-hyperaccumulating plants discovered, 318 hyperaccumulate nickel
- *Sebertia acuminata* produces a latex containing 11.2% Ni



Nickel

- *Berkheya coddii* is fast-growing and accumulates Ni to 1%
- Moderate concentrations of Ni could be remediated in 2 crops



Mercury

- Plants and planting may volatilize mercury
- EPA does not endorse media switching in most cases

Arsenic

- *Pteris vittata* quickly accumulates 10-30 times more As than in soil and grows fast
- Easy to propagate, versatile, hardy
- Grows best in warm and humid climates



Solvents

- Most common groundwater contaminant on NPL, can be found in urban industrial soils including TCE, PCE, vinyl chloride, from drycleaners and industrial processes
- Degradation in wetlands, soil and groundwater
- Accumulation in a very few plants

Pesticides



- Field studies show uptake of chlordane, DDT, PCBs by some squash varieties
- Mostly in roots
- Contaminated dust may accumulate on waxy leaves and skins

Using Plants: what works

- Plant cover keeps dust down
- Stabilization in place – proper pH, proper phosphate levels controls metal mobility
- Phytoextraction: Ni and As (not lead)
- Phytodegradation: Oil, Solvents TCE, PCE, VC, DCE, and some pesticides

Q & A

- **Contact information:**

Dr. Kirk Scheckel

US EPA

5995 Center Hill Ave.

Cincinnati, OH 45224

513-487-2865

scheckel.kirk@epa.gov