

Soil Remediation Techniques in Urban Agriculture

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Problem: 6 Tons of Contaminated Soil



view of the farm in East Garfield Park



excavated soil

Problems with Soil Toxins

- Can cause irreversible damage to both soil and humans
 - Lead: Stunt neurological development, Behavioral disorders
 - Arsenic: Carcinogen, Blood disease, Skin and heart damage
- Many routes for toxin uptake (digestion, inhalation, indirect contact)
- Heavy metals do not degrade

“Our understanding of how heavy metals in soils lead to human health risks is limited, compared to our knowledge of impacts via air or water. “

- EU report on Soil Contamination Impacts on Human Health



Brainstorming Solutions

- Raised Beds
- Compost
- Phytoremediation
- Phosphate Induced Metal Stabilization (PIMS)



Raised Beds and Compost



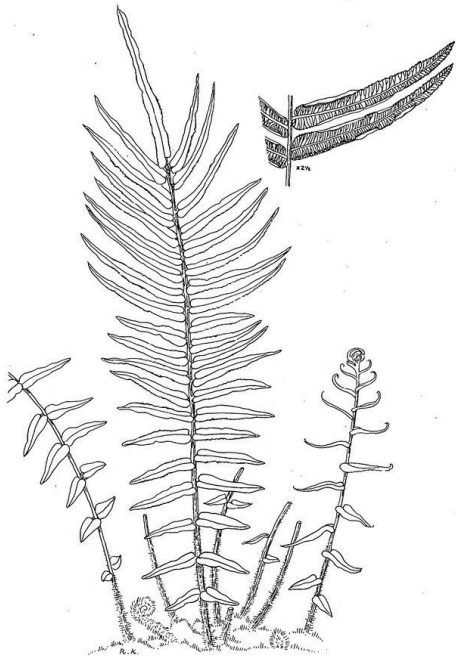
- in situ soil
- costly
- risk of contamination
- chicago's composting ordinance

Phytoremediation

- **Phytoremediation:** the use of plants that remove, degrade, or stabilize undesirable substances (such as toxic metals)
- **Phytoextraction:** a sub category of phytoremediation in which the plants uptake the toxins or heavy metals through their roots and accumulate/store in their biomass
- **Hyperaccumulators:** a plant capable of growing in soils with very high concentrations of metals, absorbing these metals through their roots, and concentrating extremely high levels of metals in their tissues

Phytoremediation cont...

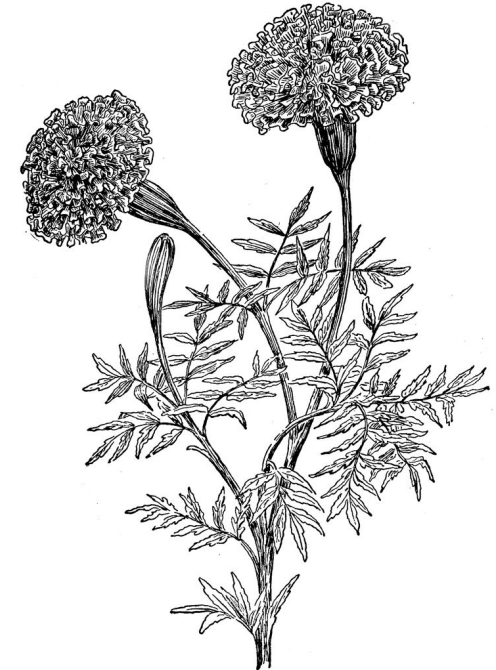
- *Pteris Vittata* (Chinese brake fern)
- *Panicum* (Explosion grass)
- *Brassica Juncea* (Mustard greens)
- Asteraceae Family (Marigolds and Sunflowers)



brake fern



panicum



marigold

Phosphate Induced Metal Stabilization

- Made from recycled fish bones
- Phosphate molecules bind to lead rendering lead unavailable for plant or human uptake
- Creates a new compound called pyromorphite
- \$25-30 per cubic yard
- Stabilizes a range of heavy metals but especially Lead, Uranium, Cadmium, Zinc, Copper, and Aluminum



apatite ii™ bags waiting to be added



adding apatite ii™

Setting Up the Project

- 10 beds of apatite iiTM
- 2 beds of ironite+apatite iiTM
- 1 bed of sunflower + apatite iiTM
 - 2 beds of ferns
 - 1 bed of panicum
 - 1 bed of indian mustard
 - 1 bed of marigold
 - 12 control beds

Soil Samples

- Loyola University Environmental Testing Laboratory
- Heavy metals acid dissolved test (\$55-70/test)

Heavy Metals (Acid dissolved)	Arsenic (As)	mg/kg	81.0	76.7	60.5	62.1	70.7
	Cadmium (Cd)	mg/kg	2.27	2.29	1.64	1.86	2.11
	Chromium (Cr)	mg/kg	6.77	6.59	5.39	4.93	5.61
	Copper (Cu)	mg/kg	30.9	39.9	35.5	848	38.2
	Nickel (Ni)	mg/kg	5.36	5.74	5.23	4.49	5.18
	Lead (Pb)	mg/kg	551	504	591	414	651
	Zinc (Zn)	mg/kg	425	371	323	301	351

Amount of heavy metal found in five soil samples taken at the site**

**soil samples were taken 15cm deep. five spaces were samples in a bed and mixed to generate one sample as heavy metal amounts can vary greatly based on location

Soil Samples

- Average Lead: 552 ppm
- Average Arsenic: 70.2 ppm
- Copper: One major outlier (848 ppm) (avg 35ppm)

Arsenic, Lead and Copper occur naturally in soils (10-40 ppm)



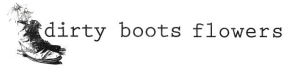
Soil Samples Cont...

- Loyola University Environmental Testing Laboratory
- Sequential extraction method (\$100/test)
- Bioavailability: “the amount of the element that can be taken and incorporated / ingested into the the body”



Community Interaction

GALLERY CONTACT ABOUT CHICAGO URBAN SOIL



Chicago flower farm and florist.

Soil Remediation Techniques in Urban Agriculture



It is commonly known that native soil in large cities is subject to contaminants such as Lead, Arsenic, and other harmful toxins. Throughout the growing seasons of 2018 and 2019 Dirty Boots Flowers and Patchwork Farms Chicago will explore ways to better the soil such as PIMS (phosphate induced metal stabilization ie binding lead through fish bones) and phytoremediation with the crops



dirtybootsflowers Did you know? Many urban soils contain contaminants and certain plants such as Brake Ferns have the power to remove toxins!

[View all 5 comments](#)

petalpushr Get em

augustmckinney Hm that is interesting. Are Brake Ferns as hearty and spread like the Lady Ferns (I think they are called Lady Ferns)?

dirtybootsflowers @augustmckinney brake ferns are native to Florida so they are not as common up here. We are experimenting with a few different methods to pull contaminants out of soil and trying to find the best balance of what is most effective as well as accessible.

augustmckinney @dirtybootsflowers you so



40 likes

JULY 27, 2018

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Safe Soils Initiative Info
Session #1

by Advocates for Urban Agriculture

Current Findings

Year One:

- Establishing baselines of soil health
- Setting up the farm and trial
- Overcoming challenges and troubleshooting

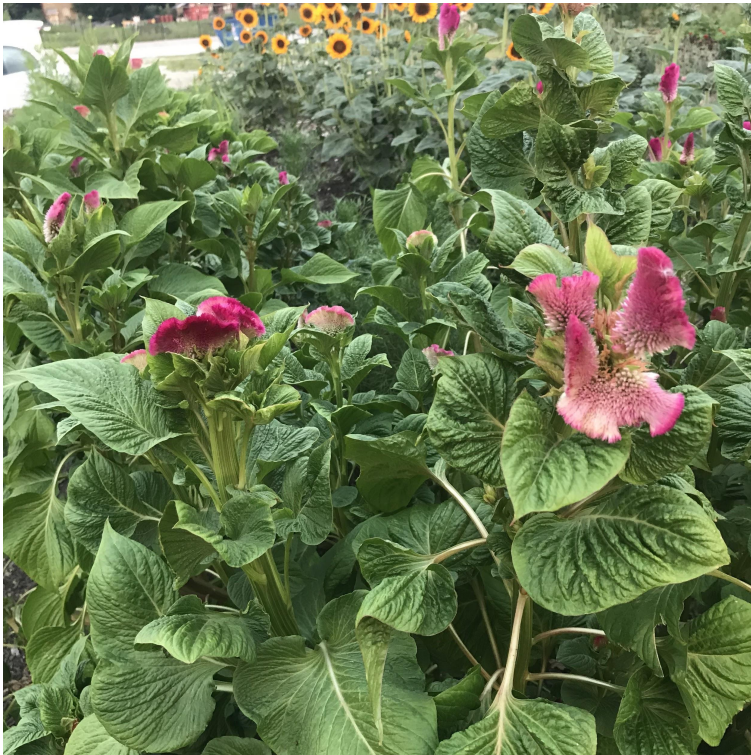
Year Two:

- Replicate the experiment using established parameters
- Conduct final soil testing
- Community engagement events



Key Takeaways

- Soil contaminants are a problem.
- There are a lot of solutions that can be implemented.
- There is a lot more work that needs to be done in this area of agricultural research.



References

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