Cleaning up lead arsenate

Katie Kirk
WHAT IS LEAD ARSENATE?

\[
\text{Pb}^{++} \quad \text{As}^{2-} \quad \text{O}^- \quad \text{O}^-
\]

CAUTION

HIGHLY TOXIC CHEMICAL
HOW BIG IS THE PROBLEM

- Millions of acres across the nation
- Washington: 188,000 acres
- Wisconsin: 50,000 acres
- New Jersey: 5% of the state (~279,000 acres)
DOES THE PUBLIC CARE?

It's Dr. Oz versus the FDA on apple juice and arsenic
September 16, 2011 | By Jeannine Stein, Los Angeles Times / For the Booster Shots blog

There's Arsenic in Your Kids' Apple Juice
—By Tom Philpott | Wed Nov. 30, 2011 12:08 PM PST

Arsenic in your juice
How much is too much? Federal limits don’t exist.
Consumer Reports Magazine: January 2012

Arsenic In Apple Juice - How Come?

Tainted Nectar? Consumer Group Warns Of Arsenic In Fruit Juice
by KRISTOFOR HUSTED

Study Finds Arsenic in Apple Juice
BY HELENA BOTTEMILLER | MARCH 16, 2010

Questions & Answers: Apple Juice and Arsenic
December 16, 2011
OPTIONS

- Excavation
- Capping
- Soil blending
- Phytoremediation

- Expensive
- Not permanent
- Hit or miss
- Slow
RISK ASSESSMENT

- Lead has low bioavailability. Amendments have to be added to increase the availability.
- Arsenate is very mobile. Precautions need to be taken to prevent erosion.
- Lead and arsénate pose risks to humans.
THE PLANTS TO SAVE THE ORCHARDS
Chinese brake fern is an arsenic hyperaccumulator.

Indian mustard, with EDTA, accumulates lead.
Green onion, with EDTA accumulates lead
Moonlight fern accumulates inorganic arsenic
Uptake of lead and arsenic in food plants grown in contaminated soil from Barber Orchard, NC

<table>
<thead>
<tr>
<th></th>
<th>Lead</th>
<th>Arsenic</th>
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<tbody>
<tr>
<td><strong>Phosphorus Temporal Field Crop</strong></td>
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<td><strong>Uptake</strong></td>
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| **Cultivated lettuce**  |       |
| Control soil            |       |
| Control soil employed for lettuce \( n=10 \), \( \mu g/g \) | \(<5\) |
| Control lettuce leaves \( n=10 \), \( \mu g/g \) | \(<5\) |
| Contaminated soil       |       |
| Contaminated soil employed for lettuce \( n=10 \), \( \mu g/g \) | \(552\pm27\) |
| Contaminated lettuce leaves \( n=10 \), \( \mu g/g \) | \(<5\) |

| **Cultivated carrots**  |       |
| Control soil            |       |
| Control soil employed for carrots \( n=10 \), \( \mu g/g \) | \(<5\) |
| Control carrot roots \( n=10 \), \( \mu g/g \) | \(<5\) |
| Control carrot shoots \( n=10 \), \( \mu g/g \) | \(<5\) |
| Contaminated soil       |       |
| Contaminated soil employed for carrots \( n=10 \), \( \mu g/g \) | \(585\pm27\) |
| Contaminated carrot roots \( n=10 \), \( \mu g/g \) | \(20\pm11\) |
| Contaminated carrot shoots \( n=10 \), \( \mu g/g \) | \(<5\) |

| **Cultivated tomatoes**  |       |
| Control soil            |       |
| Control soil employed for tomatoes \( n=10 \), \( \mu g/g \) | \(<5\) |
| Control tomato fruit \( n=10 \), \( \mu g/g \) | \(<5\) |
| Control tomato shoots \( n=10 \), \( \mu g/g \) | \(<5\) |
| Contaminated soil       |       |
| Contaminated soil employed for tomatoes \( n=10 \), \( \mu g/g \) | \(569\pm38\) |
| Contaminated tomato fruit \( n=10 \), \( \mu g/g \) | \(<5\) |
| Contaminated tomato shoots \( n=10 \), \( \mu g/g \) | \(<5\) |

| **Wild blackberries**   |       |
| Blackberry fruit \( n=10 \), \( \mu g/g \) | \(<5\) |
| Blackberry branches and leaves \( n=10 \), \( \mu g/g \) | \(<5\) |

established for As in fertilizer, however, the effects on phosphorus are more significant. Indicate that MAP starter fertilizer can increase As uptake under field conditions; however, the effects on phosphorus are more significant.
Name one plant that can be used to accumulate arsenic.
POTENTIAL AMENDMENTS
ELECTRODICS AND EDTA FOR LEAD

![Graph showing the impact of EDTA on lead concentration in shoots](image)

- **0 mmol/kg EDTA**
- **2 mmol/kg EDTA**

**Pb Conc. in Shoots (mg/kg)**

- **Control**
- **30 Min**
- **60 Min**

**Voltages**

- **10 V**
- **30 V**
PHOSPHATE ROCK AND SODIUM POLYACRYLATE FOR ARSENIC
Name one amendment that can be used to increase uptake of arsenic.
WHAT NEEDS TO BE DONE

- Phytoremediation needs to be proven as a viable option
- Further research needs to be done to find other hyperaccumulators
- All sites that have been converted need to be tested
- Barriers need to be set up to prevent erosion of contaminated soil into waterways
WHAT IS BEING DONE

- Government is helping residents pay for clean up
- Government is cleaning soil where there is more likely to be contact with people, especially children


Pendergrass, A., Butcher, D. J. 2005. Uptake of lead and arsenic in food plants grown in contaminated soil from Barber Orchard, NC. *Microchemical Journal.* 83:14 – 16


