CCA Pressure Treated Wood around the House and Garden

by David Stilwell and
Craig Musante

- **Environmental Effects**
- **Coating the Wood to Reduce Exposure**
- **Plant Uptake of Arsenic (As)**
- **Alternative Preservatives and Products**

Pressure Treatment –
Injects preservatives deeply into the wood.

1. **Load Wood onto Tram**
2. **Apply Vacuum to Remove Air from wood Cells**
3. **Pump Wood preservative Solution into Wood under Pressure**

Picture Courtesy of Hickson Co.

Pressure Treated Wood is Used in-

- Decks
- Playscapes
- Fences
- Picnic Tables
- Docks
- Landscaping
- Traffic Sound Barriers
- House Foundations

WOOD PRESERVATIVES

- **Extends life of wood**
- **Protects wood from harmful organisms such as termites and fungi**
- **Reduces use of forest products**

CCA Wood Preservative

- **By far the most common wood preservative formulation in use prior to Jan 1 2004.**
- **Copper, Chromium, Arsenic**
- **0.2% Cu, 0.3% Cr, 0.3% As in the wood (Typical)**
- **Higher amounts for foundation and marine.**

CCA WOOD CONTAINS INORGANIC ARSENIC

- **Class A carcinogen**
- **#1 in EPA'S Priority List (CERCLA)**
- **In Z-List of toxic substances (OSHA)**

*Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA)

AND THIS ARSENIC

- **Leaches from the wood into the soil**

- **Is Dislodged from the surface upon contact**

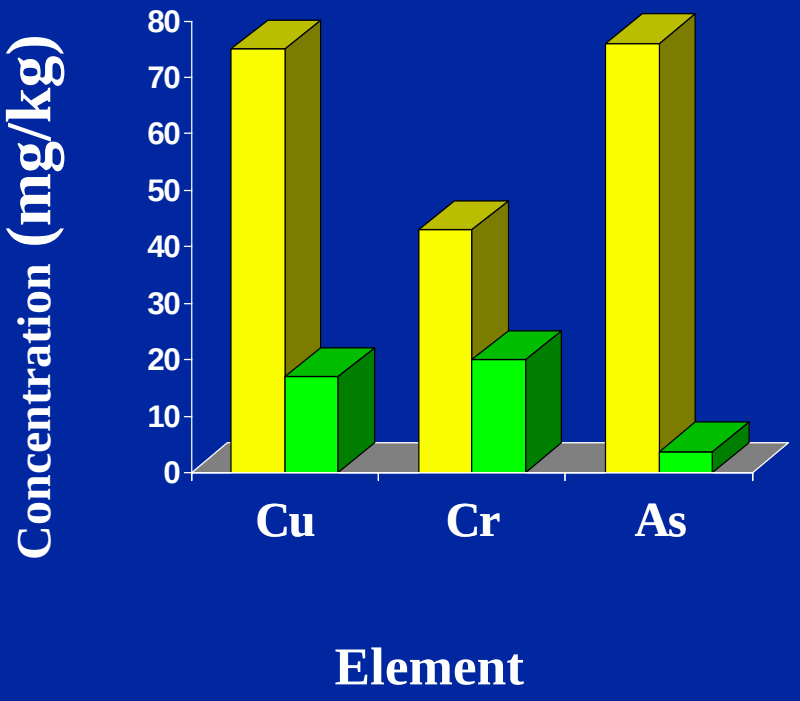
Examples of Studies Showing Arsenic Leaching

- **Connecticut (CAES)**
  - **Soils under Decks and Sound Barriers**
- **Florida**
  - **Soils under Decks and Playscapes**
- **New Jersey**
  - **Soils under Wetland Boardwalks**
- **Canada**
  - **Soils by Utility Poles**
- **Numerous**
  - **Lab and Outdoor Leachate Collection Studies**

CAES STUDY -HIGH AMOUNTS OF ARSENIC FOUND IN SOILS UNDER DECKS

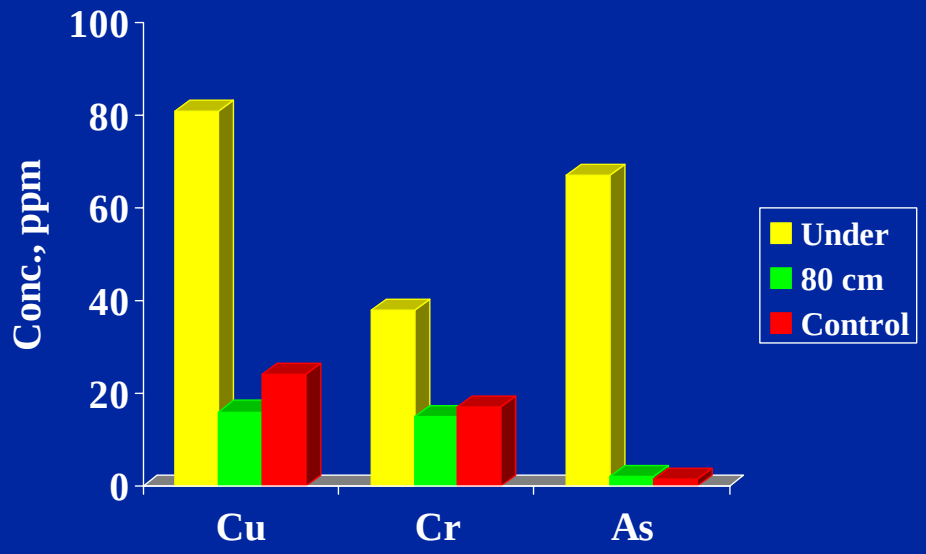
7 Decks, 85 samples under decks –

Range 3-350 ppm
Average 76
(CT limit = 10)



CAES STUDY - SOUND BARRIERS–3 Locations

(n=35 Under; n=15, 80cm Away and Background)



Average Arsenic Under = 67 ppm, Range 7-228

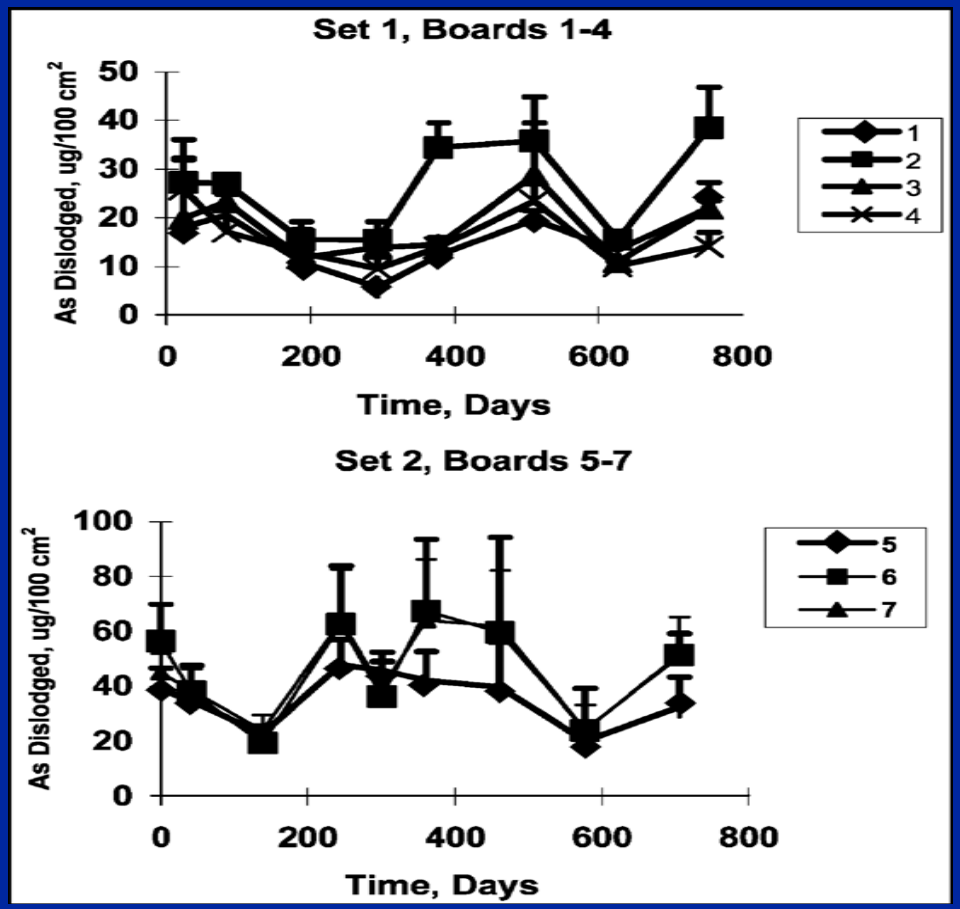
Arsenic Dislodges from CCA Wood Surfaces

- **Such surfaces include playground equipment and decks built with CCA treated wood.**
- **Exposure is hand to mouth.**

Test Coupons

Playscapes

Arsenic Dislodged from Surfaces onto Wipes



THE PHASE-OUT

- **Mounting evidence of arsenic exposure by government agencies, public interest groups, and investigative reporters led to an agreement to phase-out most residential use by Jan 1 2004.**
- **BUT - In-service wood expected to remain for many years**

Coating CCA Wood -

- **Has been shown to reduce Leachable and Dislodgeable Arsenic**

- **Draft of EPA model predicts substantial decrease in As exposure, assuming 90% and 99.5% reduction in CCA residues on playsets by coatings.**
- **Lifetime Average Daily Dose (LADD)**
  - **Reduced by factor of**
    - **6-7 (90% reduction)**
    - **11-17 (99.5% reduction)**

Coating Variables

- Formulation – water/oil based
- Additives and Pigments-
- Coating environments –
  - outdoors above ground
  - in soil
  - in water
- Physical wearing (foot traffic)
- Surface preparation – old wood

COATING THE WOOD REDUCES ARSENIC LEACHING AND DISLODGMENT

ABOVE GROUND

- Film Forming and Penetrating Finishes (Polyurethane, Acrylic Latex, Oil based)

BELOW GROUND

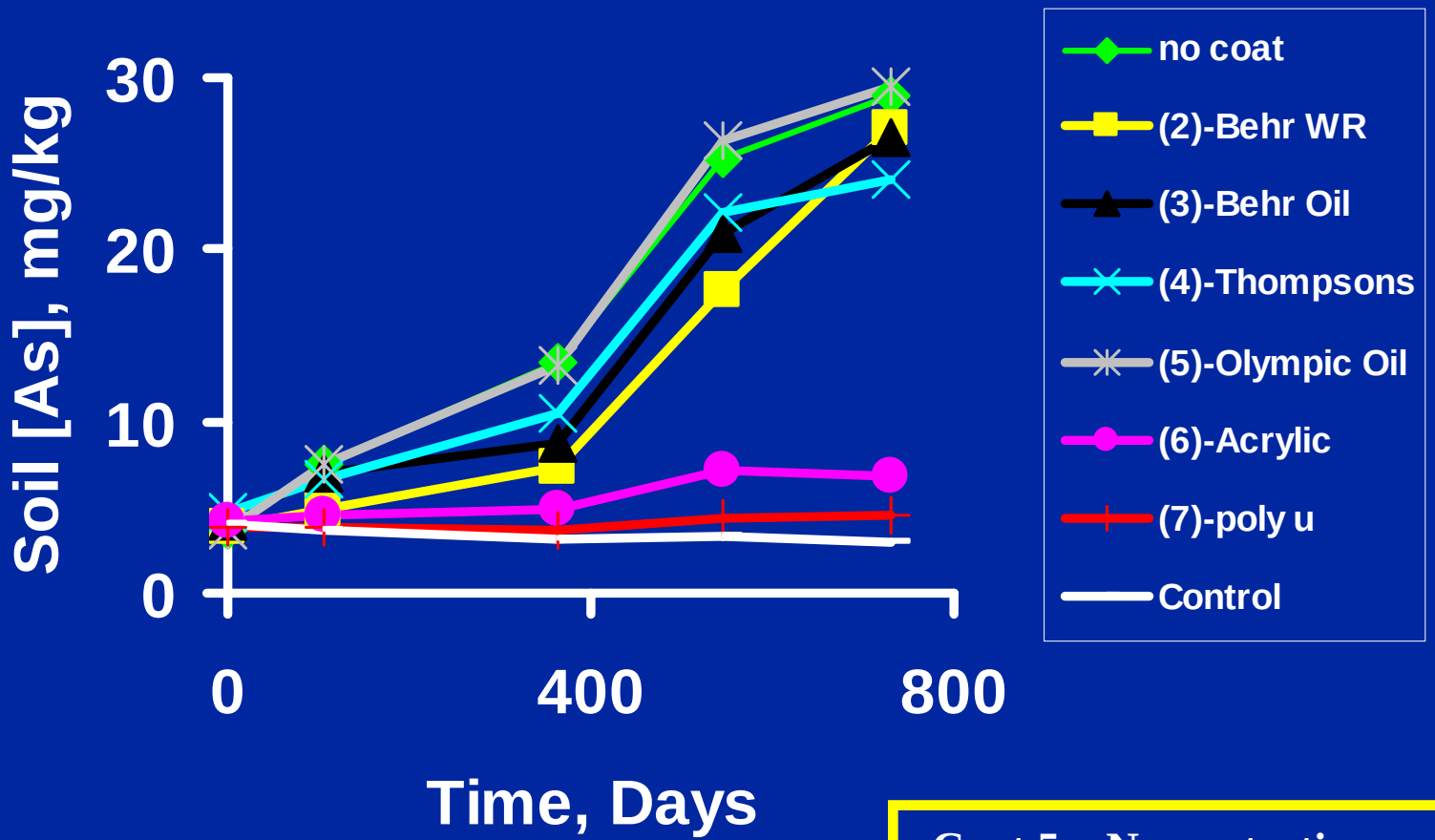
- Only Opaque Film Forming or Plastic Film

EPA/CPSC STUDY – Interim Results

- 12 Coatings- Film Forming and Penetrating
- 11 months –% Reduction in Surface As
  - 4 >90% reduction
  - 3 - 75-90% reduction in As
  - 4 <75% effective
  - 1 Effective but deteriorates
- No clear trend in product type but 2 of the top 4 were film formers (opaque)

Ground Contact - day 1

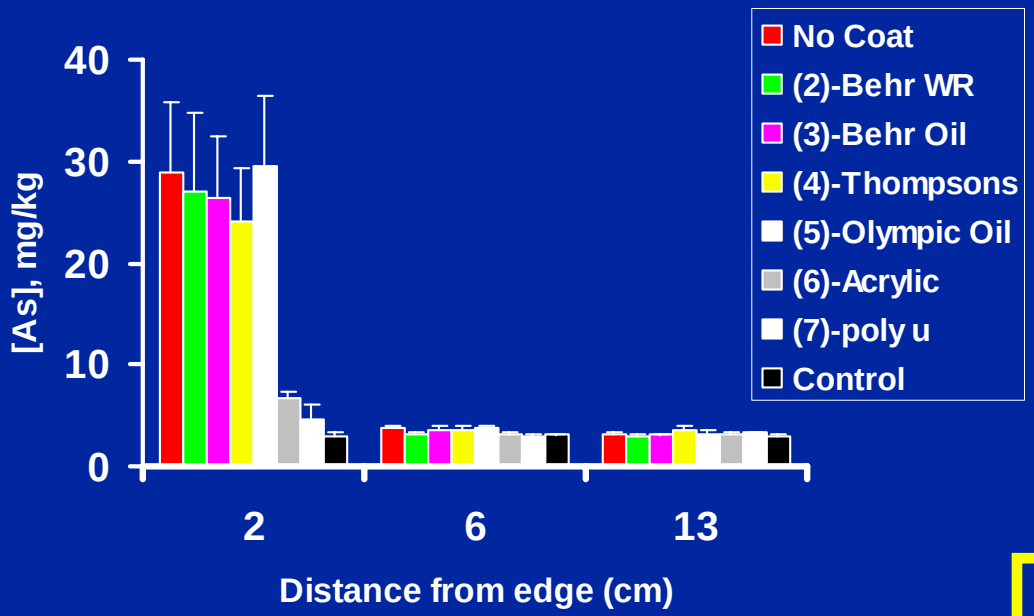
Soil As over time- 2 cm from box edge

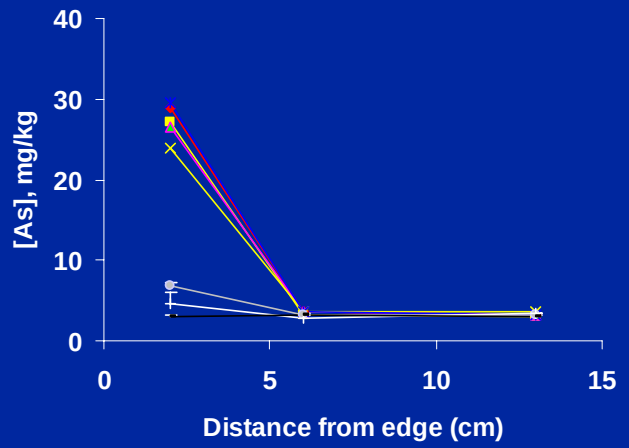


-no coat linear?- R^2=0.97
-Coats 2-4 only effective up to 1 year then Same slope as No coat

-Coat 5 – No protection
Coat 6 – Good protection over 2 years.
Coat 7 – Excellent Protection over 2 years.

Soil As with Distance from Box Edge After 2 Years of weathering





No Coat 2cm	**29±7 mg/kg As**
6 cm	**3.7±0.2**
13 cm	**3.2±0.1**
Control	**3.1±0.1**

*Coatings Conclusions, Recommendations**

- **Film Formers - Polyurethane and Acrylic: >80% Reduction above and below ground**
- **Penetrating Finish: Good reduction above ground but not on soil contact**
- **Oil Finish wears Uniformly and Does not Chip – May Be Preferred on Foot Traffic Surfaces**
- **Fully Pigmented > Semitransparent > Unpigmented**
- **Consult with paint dealer**

CAES, Consumer Reports June 2002,** ***Feist and Ross, "Performance and Durability of Finishes on Previously Coated CCA-Treated Wood" 1995, Forest Products Journal

Plant Uptake of Arsenic

- **Potential Uptake When Growing Edible Plants Near**
  - **Raised Beds**
  - **Fences**
  - **Landscape Timbers**
  - **Deck Perimeter**
- **Made from CCA wood**

Plant Uptake of Arsenic

- **Depends on Edible Part of Vegetable**
  - **FRUIT (tomato) << LEAF, ROOT**
- **Depends on Vegetable**
  - **Brassica (mustard greens) and arugula- good uptake and growth**
- **Depends on Soil type and on soil additives**
  - **Phosphorus (P)– Releases As from soil (OPPOSITE TO LEAD)**
  - **Iron (Fe) and Calcium (Ca) – Bind As in soil**
- **Compost reduces plant uptake of arsenic**

Plant Uptake in Boxes

- After two year weathering – Brought into greenhouse – plant seedlings
- Arugula – 7 plants, 2cm from edge, 2 sides
  4 plants, 6 cm from edge, 2 sides
  1 plant in center of box (13 cm)
- Romaine Lettuce – 6 plants, 2cm, 2 sides
  2 plants, 6cm, 2 sides
- Basil, Chives – 2 each box in corners
- Harvest after 21 days (Arugula, Lettuce), 28 days (basil, chives)

In Boxes -16 days after transplant

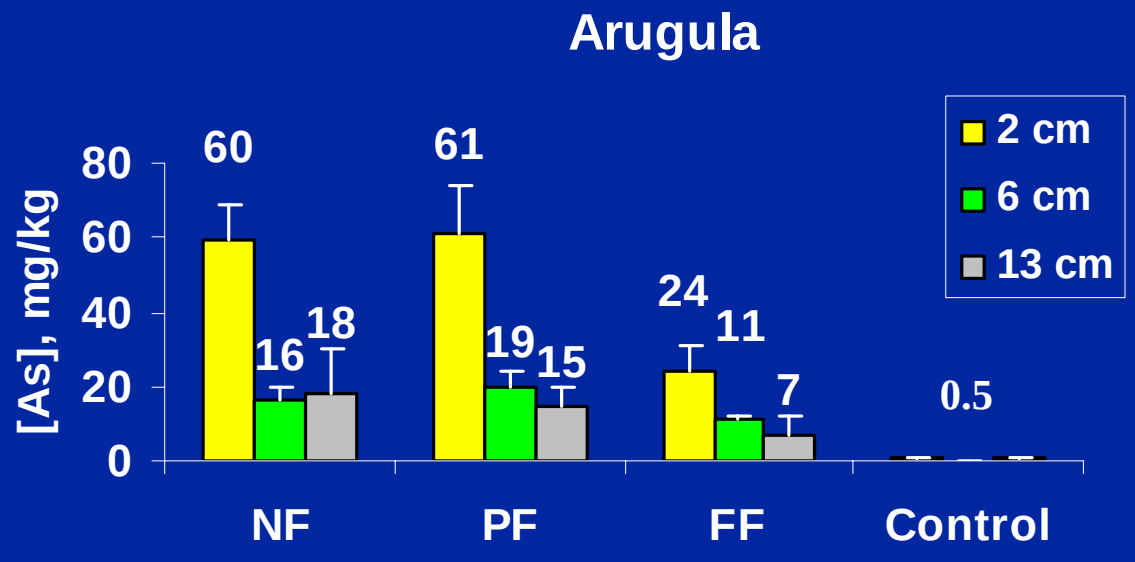
As in Soil and plants (mg/kg, dry wt.)

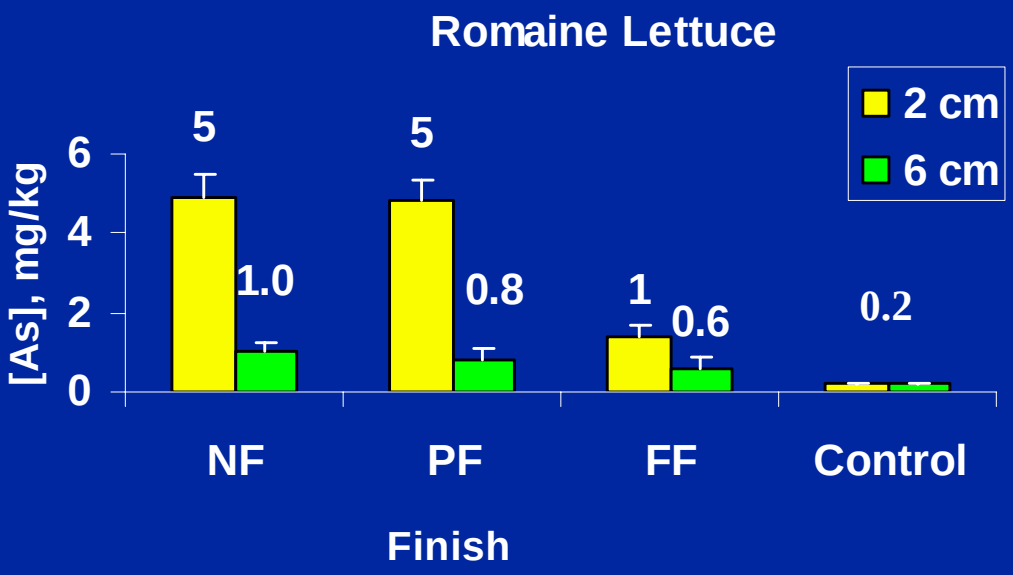
2cm from edge, after 2 years weathering

Finish	Soil	Arugula	Chive	Basil	Lettuce
None	29±7	60±9	75±19	6±2	5±0.6
PF	27±6	61±13	75±24	10±3	5±0.5
FF	6±2	24±7	12±3	3±0.3	1.4±.3
Control	3±0.2	0.5±0.2	<0.2	1±.07	0.2±0.01

PF- Average all Penetrating Finishes, FF- film forming

Brit Limit Plants - 10-14 mg/kg dry wt. basis (1 mg/kg fresh wt.)





As (mg/kg, dry wt.) in Arugula and Lettuce

2,6, 13 cm from Box edge.
PF=Penetrating Finishes
FF= Film Forming
NF= No Finish

- 55-85% reduction with distance from box edge
- Arugula >10 in As in most cases and above Control (0.5 mg/kg)

Summary
As in Plants Grown in Boxes

- **Arugula, Chives >> Basil, Lettuce**
  - **Arugula and Chives exceeded Brit limit (2cm from wood)**
- **REDUCED BY COATING-**
  - **50-85% reduction when grown next to wood coated with Film Forming Finishes**
- **REDUCED BY DISTANCE-**
  - **55-85% reduction in uptake by lettuce and arugula grown 6 cm from edge compared to 2 cm from edge.**

Comparison of As in Plants grown in boxes to pot studies (6-packs)

- **50/50 mix by Vol.– Soil + promix.**
- **Box Soil 2cm (30 ppm As)**
- **CCA contaminated soil (160 ppm As)**
- **PbAsO4 Contaminated (25 ppm As)**
- **Spiked Soils (20-30 ppm As)**
- **Control Soils (3-9 ppm As)**
- **Arugula, Lettuce, Basil, Chives**

Plants grown in 50/50 by vol Soil/promix –

Harvest 21, 28 days after transplant from seedling tray.

Spiked init.
25 ppm As

Various soils- plot – PbAsO4 contaminated, CCA – CCA contaminated – under deck- Windsor, Merrimac, Lockwood – Spiked Sandy Loam

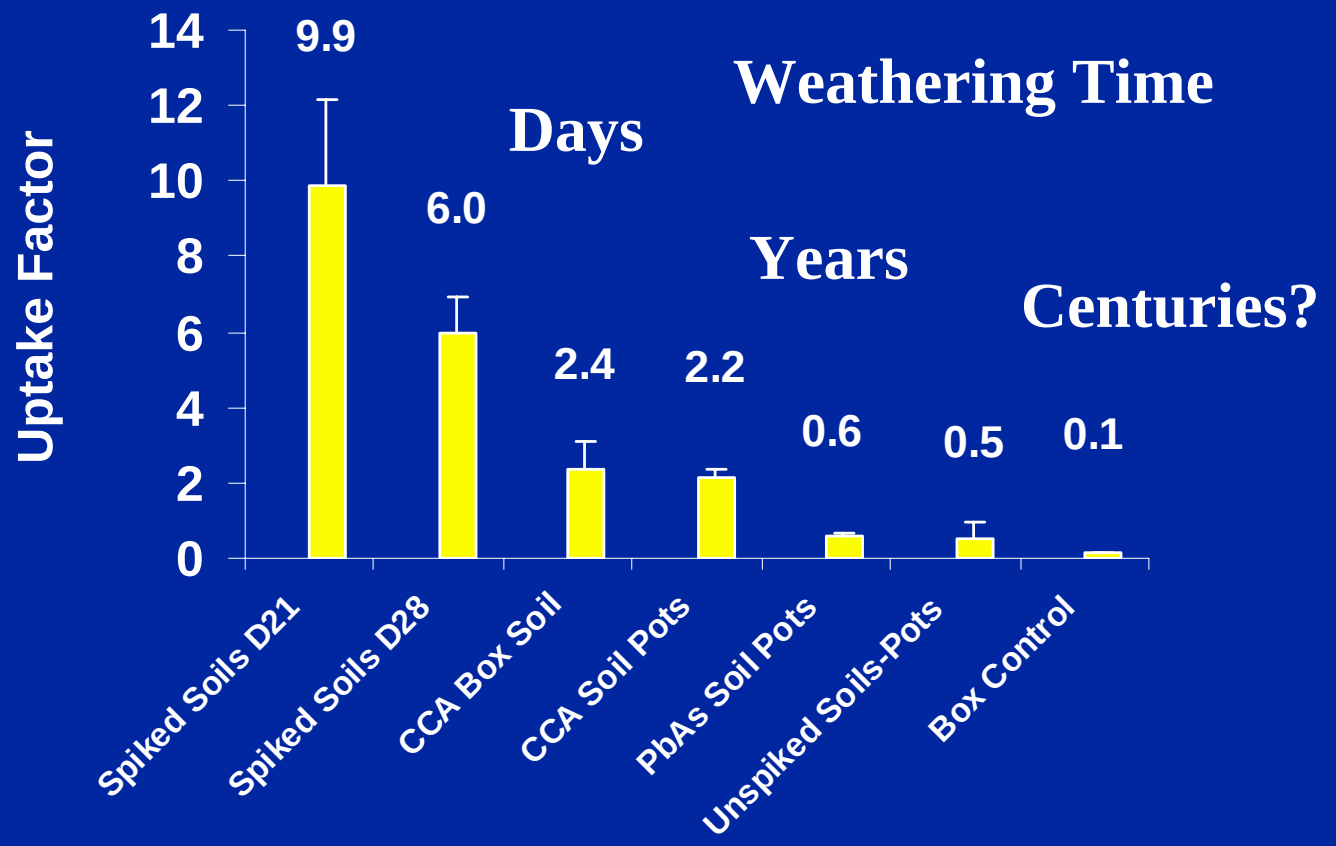
Growth Trials- in Pots and Boxes

		Plant [As], Avg. mg/kg, dry wt.			
Soil Type	**Soil [As]**	**Arugula**	**Lettuce**	**Chive**	**Basil**
Box	**30**	**60**	**5**	**75**	**6**
Deck-CCA	**160**	**340**	**50**	**145**	**85**
Plot-PbAsO4	**25**	**15**	**3**	**10**	**16**
Spike Day21	**25**	**200**	**----**	**----**	**----**
Spike Day28	**25**	**120**	**----**	**----**	**----**
Control	**3-9**	**0.5-4**	**0.2**	**<0.2**	**1**

Brit. Limit -10-15 mg/kg, dry wt. (1 ppm fresh wt.)

ARUGULA - Uptake Factor

[As, plant]/[As, soil]



Comparison's As (mg/kg)

Ref	Type	Soil	Plant	Type of Plants
1	CCA-BOX	30	5-60	Arugula> Chives> Basil>Lettuce
1	CCA-Pots	160	50-340	
2	CCA-Pots	25-45	4-44	Carrots, Lettuce (Carrot>Lettuce)
2	CCA-Pots	" "	40-200	+P (2-10x Higher)
2	CCA-Pots	" "	1-8	+Compost (~80% Lower)
3	CCA-Pots	31	4-6	Carrots, Lettuce, Turnips
4	CCA-Pots	40-50	0.3-3	Carrots, Spinach, Buckwheat, Beans
1	PbAsO4-Field	60	<1	Tomato, Cucumber, Zucchini

1- CAES, 2-Cao&Ma Fl, 3- Shiralipour Fl, 4 Rahman et al. Mn

Conclusions Plant Uptake of Arsenic

- **Plant uptake of Arsenic can be substantial (arugula), but is reduced in plant grown next to opaque coated wood, and with distance from edge.**
- **Avoid growing Arugula, Brassica (mustard, collards), leafy vegetables, root vegetables near CCA wood.**
- **Plant perennials at interface of wood and soil (no edibles within a foot or so)**
- **Coat inside with opaque coating or line with plastic barrier**
- **Coat outside with paint or stain to reduce leaching and physical dislodgement**
- **Limit Phosphorus (Phosphorus releases arsenic)**
- **Add Compost – Reported to Bind with Arsenic**

The New Preservatives

- ACQ (Preserve)
  - Copper
  - Didecyl dimethyl ammonium chloride (quat)
- Copper Azole (Natural Select)
  - Copper
  - Tebuconazole
- Borates
  - Alone or Can be added to copper azole

The New Preservatives –

- **Do not contain EPA listed compounds***
- **Do not contain known or suspected carcinogens***
- **Much less toxic than CCA***
- **ACQ - Green Chemistry award 2002**
- **Toxicity of copper on aquatic organisms may present a problem in marine applications**
- **Use approved fasteners (SS, Hot Dip galvanized, etc.)- Look for ACQ wood "Fastener Information Sheet"**

***ewg-poisoned playgrounds, Solo-Gabrielle 2000**

Wood Composites, Plastics

- Composites
  - About 50% plastic (Typical Recycled HDPE)
  - And 50% Sawdust (Pine, Cedar, rice hulls)
  - Commonly Decking
- Plastic
  - Polyethylene
  - PVC (polyvinyl chloride)
  - Commonly Fencing and Railing

TREX

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