

**Determining the Worker  
Insecticide Exposure Potential of  
Harvesting Pine Seed Cones  
in U. S. Forestry**

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*At the molecular level*

# WE LIVE IN A CHEMICAL WORLD

- “What is food for one, is fierce poison for another.” Lucretius, Roman poet and philosopher, ca. 94 B.C.
- “Dose determines a poison....” Paracelsus, German alchemist, physician, astrologer, occultist, 1493-1541

- **There is a safe level of everything!**

*Sing to the tune of “You’ve Got To Be Taught, Before It’s Too Late!”*



# UC Riverside

Bob Krieger

Helen Vega

Jimmie Keenan

Yanhong Li

Melinda Bigelow

*and lots of VGCs*

# Dose and Biomonitoring

- Volunteer Man
- Beer Drinking Man
- 60% body water

- 3.2% alcohol
- 2 beers
- 23 g alcohol
- 60,000 g water
- 0.03% BA
- 30,000 ethanol ppm

## ***Urine***

39,000 ppm

# What is extent of worker exposure during pine cone harvesting?

- Conduct exposure assessment (amount/person-day)
- Protect existing registrations
- Enable new ones

- Scientific, state-of-the-art
- Political challenge
- Survival strategy

**Krieger et al.**

**UCR**

**Riverside**



**Evans et al.**

**EPA**

**Washington, D.C.**



**Taylor**

**Forest Service**

**Atlanta**



**Byram**

**A & M**

**College Station**



# Safe Entry Levels For Harvesters Of Treated Crops

- California Citrus
- Chlorinated Hydrocarbons
- Safe to eat, safe to pick

# Safe Entry Levels For Harvesters Of Treated Crops

- California Citrus
- Chlorinated Hydrocarbons
- Safe to eat, safe to pick
- Food tolerances (ppm)

- UC Riverside et al.
- Organophosphorous Insecticides
- Orchard entry illnesses
- *Dislodgable Foliar Residues (DFR, ug/cm<sup>2</sup>)*



Exposure is contact with potential absorption and distribution, metabolism, and elimination that limit response [adverse effect].

- **External dose (mg)**
- Deposition on clothing or skin, 20,000 cm<sup>2</sup>/person
- Clothing penetration
- Skin absorption
- Absorbed dose

**External  
Dose  
(1000s ug)**

**Transfer Factor,  
5,000 cm<sup>2</sup>/h**



**Dislogable Foliar Residue, DFR (ug.cm<sup>2</sup>)**

$$\text{Dose} = \text{DFR} \times \text{hours worked} \times \text{TF}$$

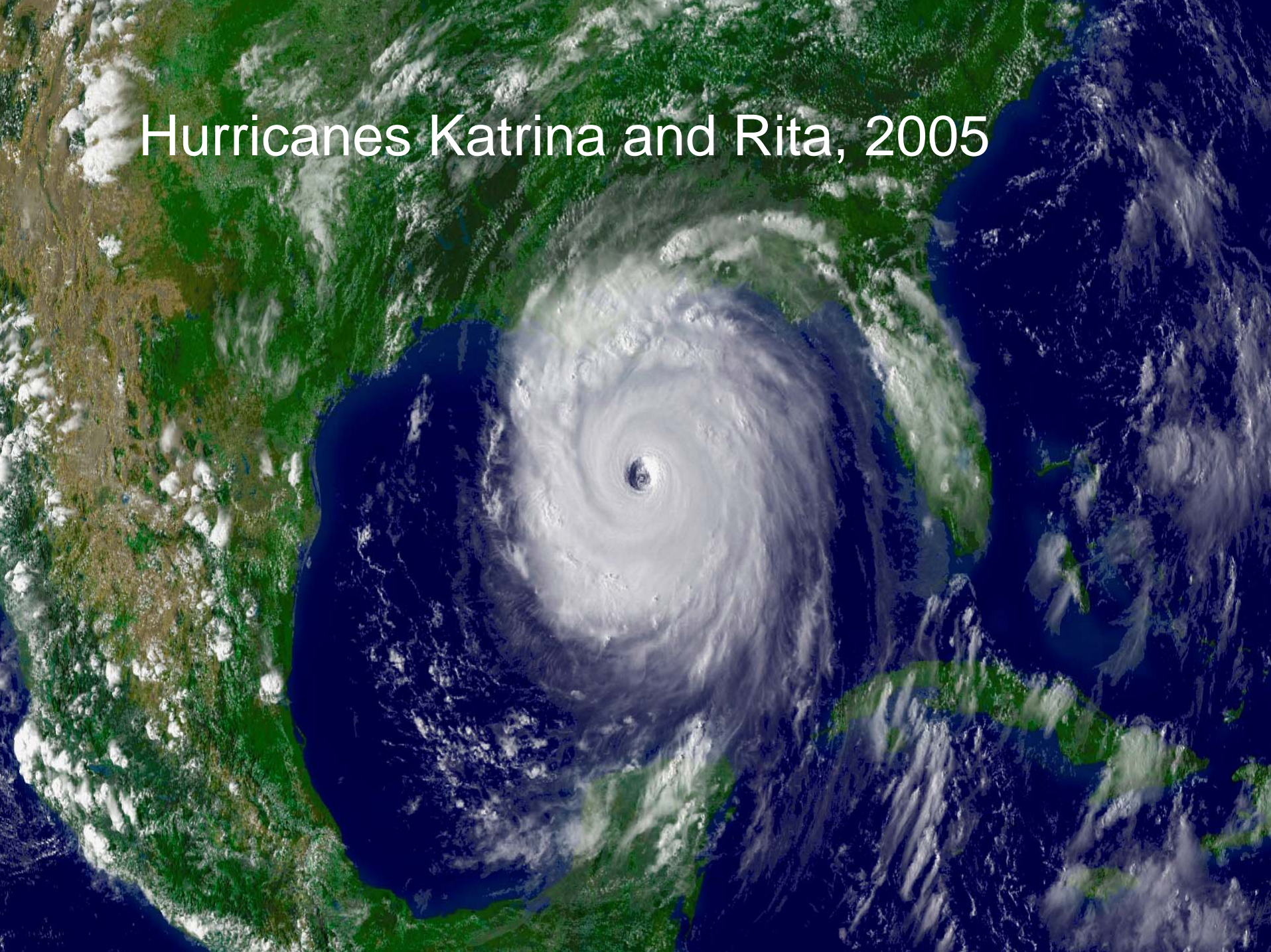
Exposure is contact with potential absorption and distribution, metabolism, and elimination that limit response [adverse effect; toxicity].

- ***External dose (mg)***

- Deposition on clothing or skin, 20,000 cm<sup>2</sup>/person
- Clothing penetration
- Skin absorption
- Absorbed dose

- Urine biomarker
- % eliminated in urine
- % per day
- % absorbed
- Parent/Metabolite
  
- ***Internal Absorbed Equivalent Dose (mg)***

# Hurricanes Katrina and Rita, 2005



# STUDY DESIGN

CHECK IT OUT!

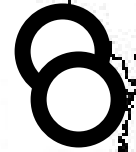
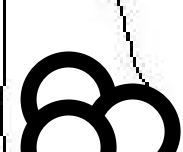
- Record regional experience
- Environmental monitoring not productive
- Biomonitor pine cone harvesters
- Engage US EPA

**Washington, D.C.**

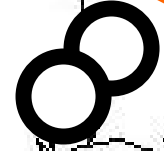
**UC Riverside**



***Pensacola***



**De Ridder**



**Oliver**

**Kirbyville**

**Brewton**

**Camden Jesup**

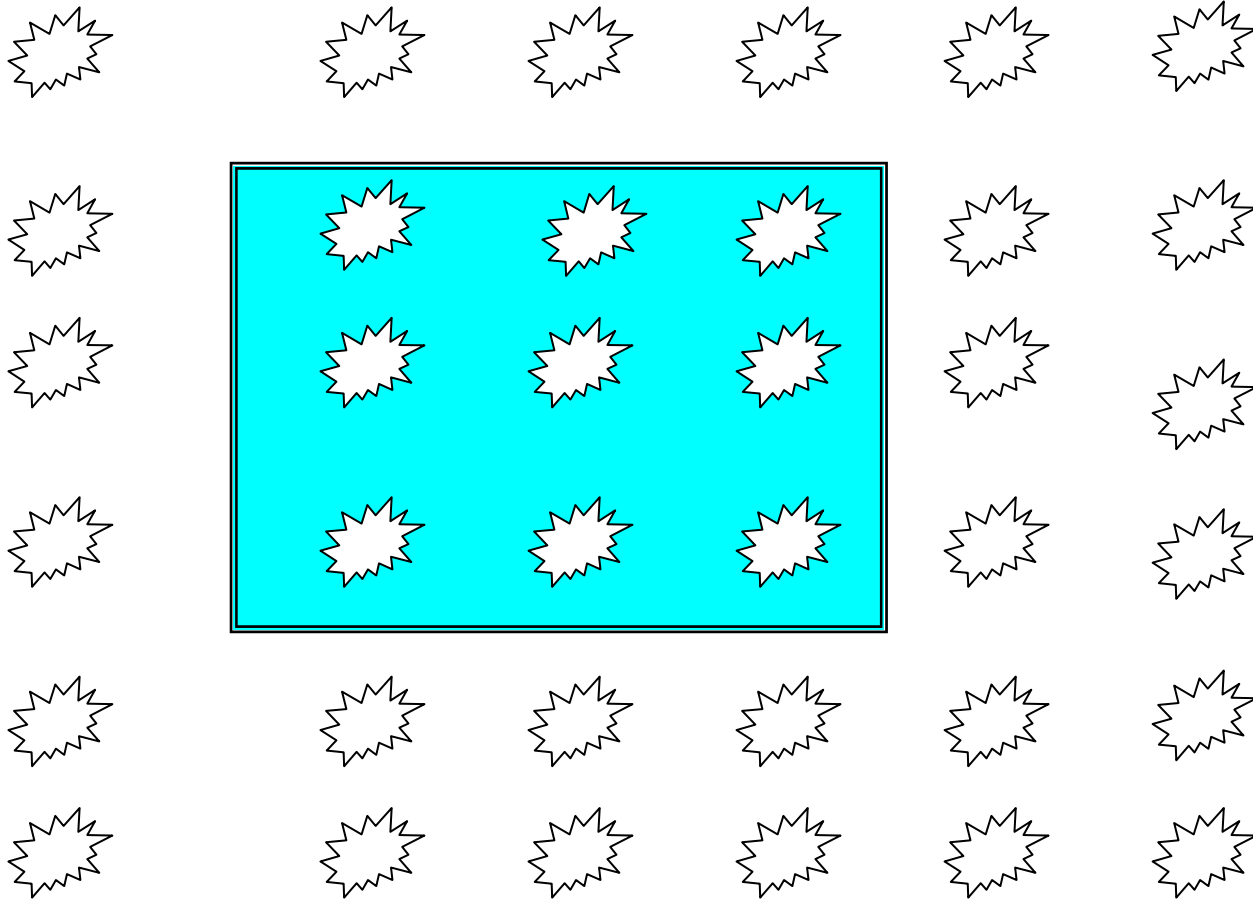
**Dothan**

[jwtaylor@fs.fed.us](mailto:jwtaylor@fs.fed.us)

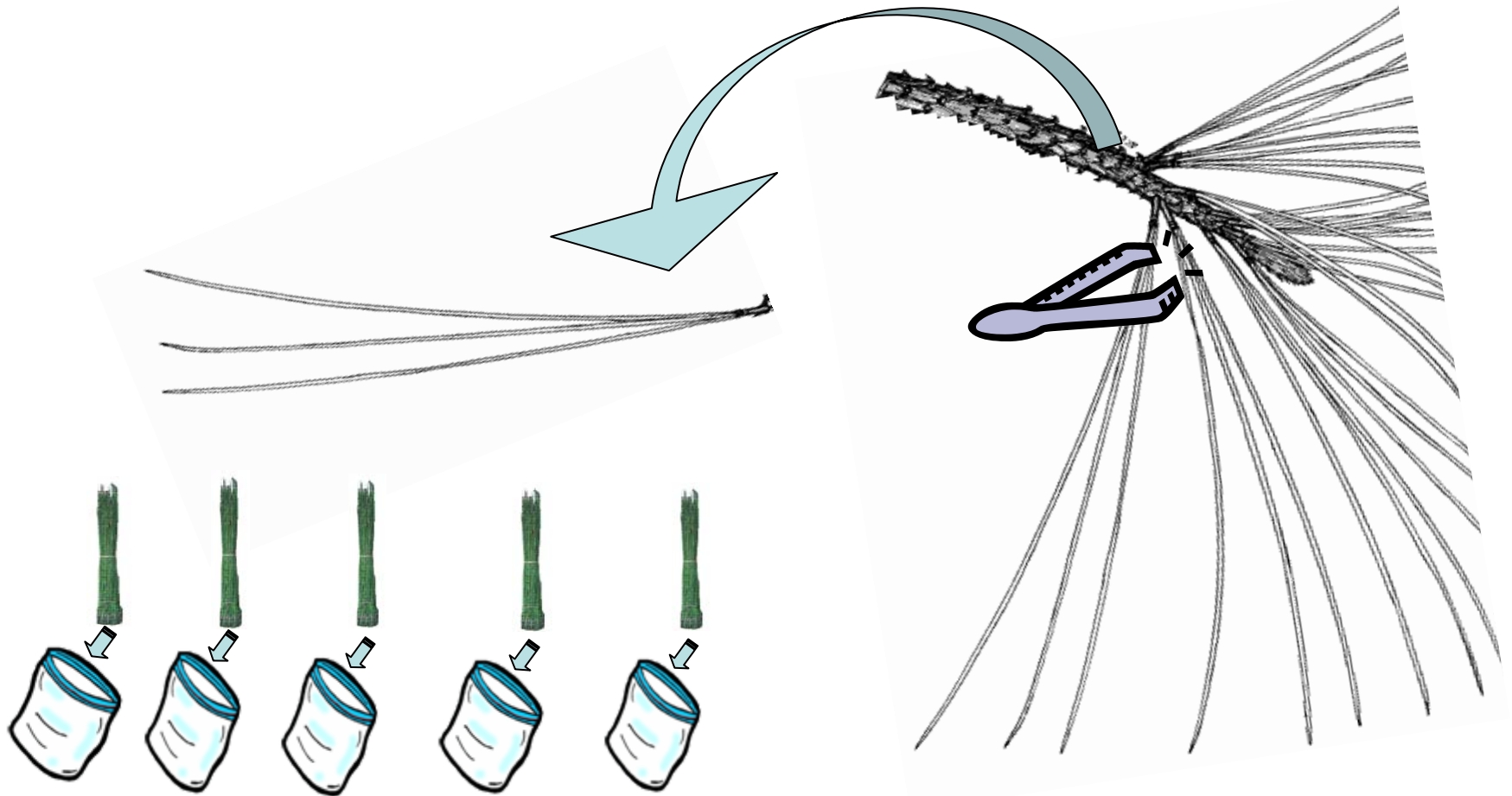
Atlanta, GA

**Glen Allen**

# PINE CONES



# PINE NEEDLES





# 10 SITE EXPOSURE ASSESSMENT STUDY

largest ever by number of sites and cooperators!

- Insecticide Use 2006

- OP

- Guthion 6

- Malathion 2

- Pyrethroid

- Asana 29

- Bifenthrin 12

- Permethrin 1

- Urine Biomarkers

- DAPs

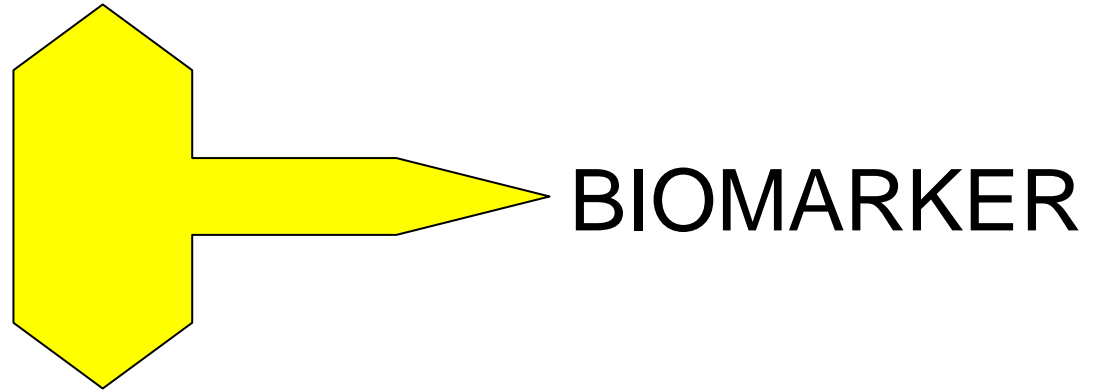
- Dimethyl

- Dimethylthio

- Phenoxy benzoic acids (PBAs)

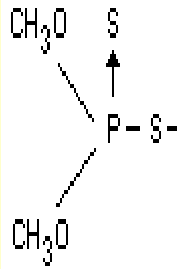
# URINE BIOMONITORING

- PARENT INSECTICIDE



- BIOMARKER in ENVIRONMENT

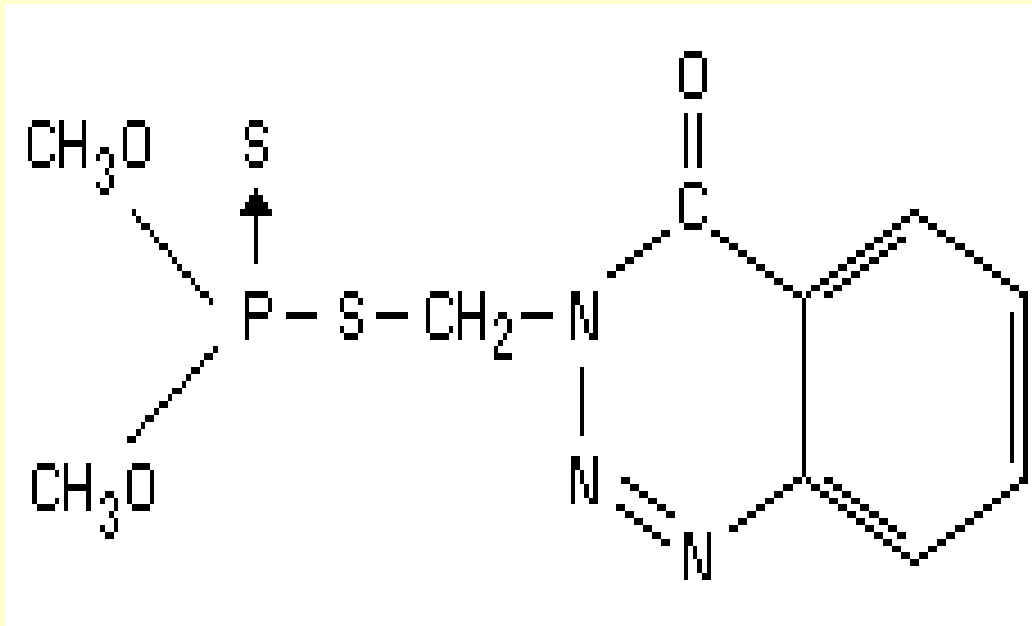
Biomarker/ml  $\longrightarrow$  Dose/day



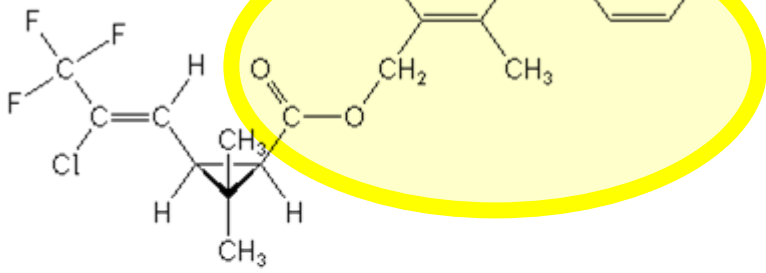
DAP

# Guthion

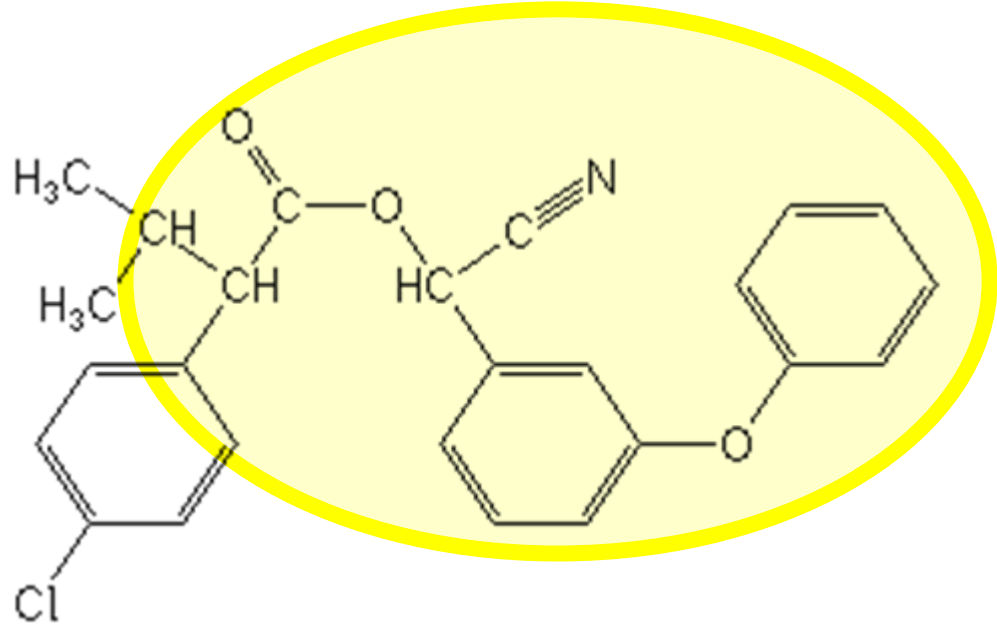
(Azinphos-methyl)



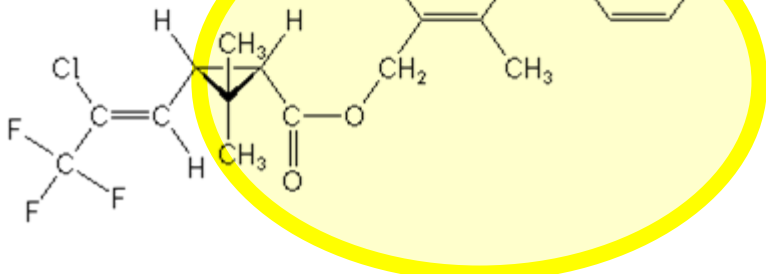
(Z)-(1R)-cis-acid



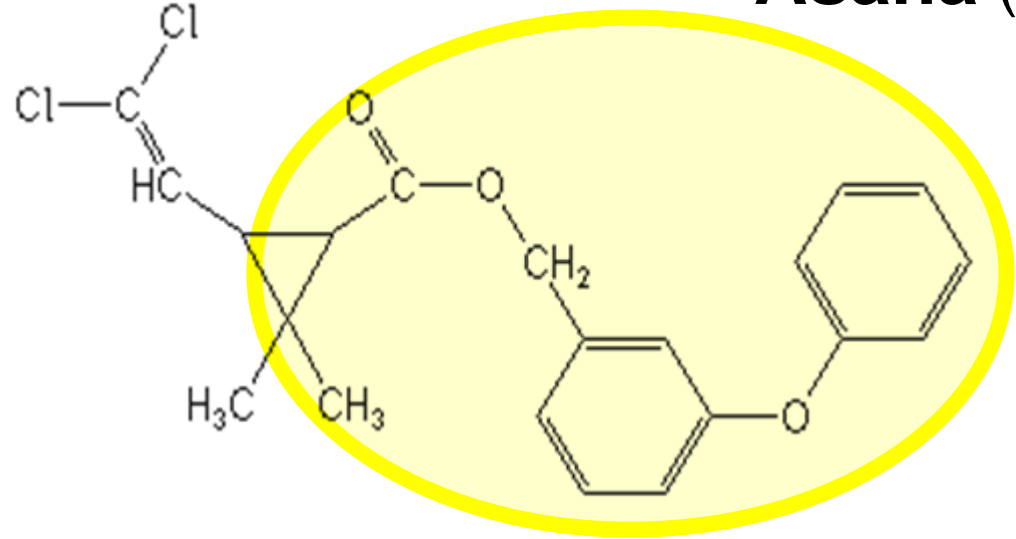
Bifenthrin (Capture)



(Z)-(1S)-cis-acid



Asana (esfenvalerate)



Permethrin

## Biomarker Levels in Harvester Urine

- DAPs are present at levels that are similar to those of the general population of the U. S.
- At the LOAEL = ?

- PBAs will be measurable at similar levels (nanograms per ml urine)

BK: We have shown that pine cone harvesting is very low exposure work!

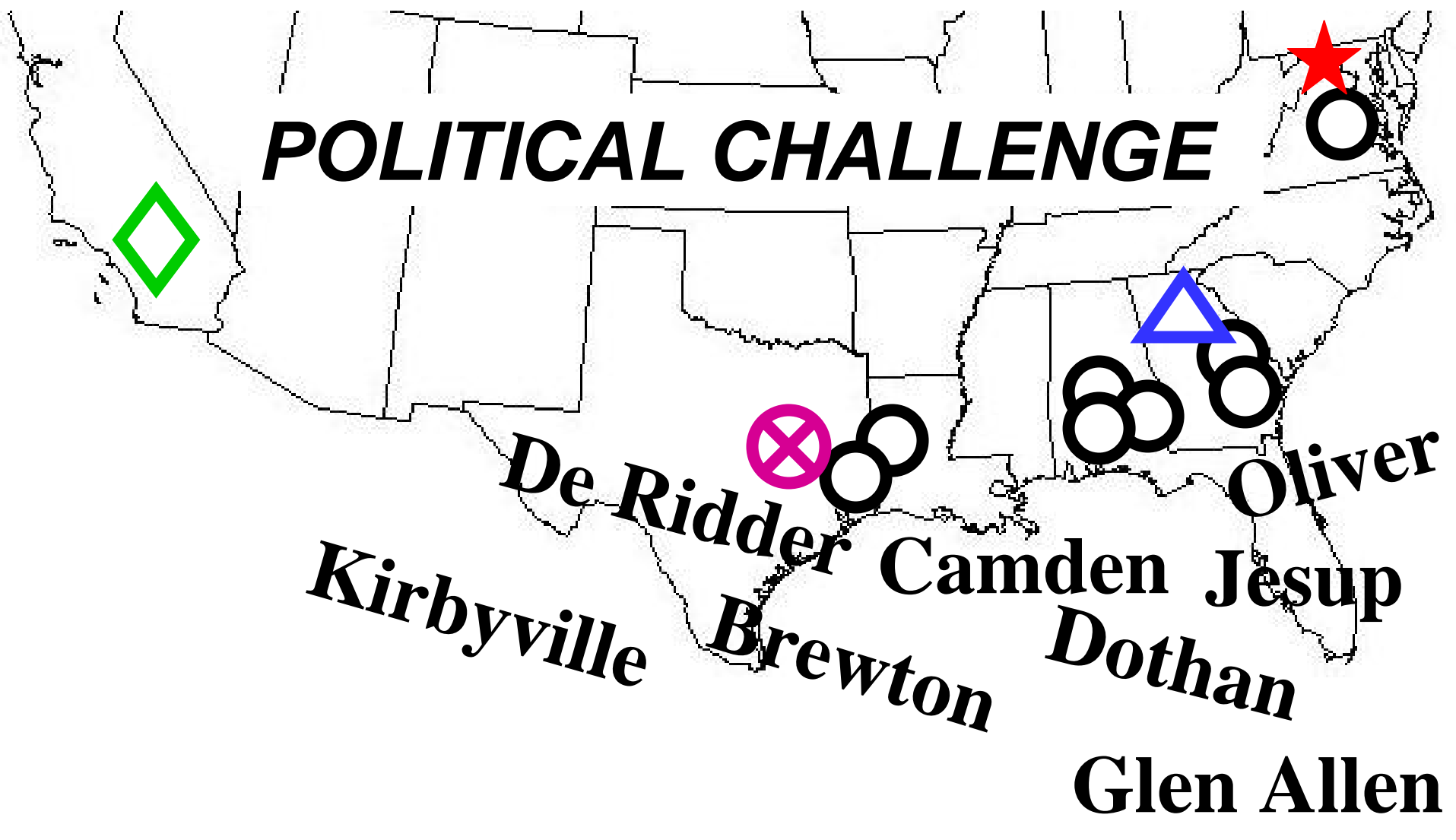
EPA: I like the approach. It is damn good data, no doubt about that!

BK: Pine cone harvesting can not be regulated like it is a row crop like strawberries or corn!

Personal hygiene, clean equipment and good labels will get you to safe use!

May 3, 2007 conversation

# ***POLITICAL CHALLENGE***



# Survival Strategy for Pesticide Use in Forestry IPM

- Lobby to simplify labels especially with respect to ***pesticide drift***
- Implement ***universal worker biomonitoring*** as a training and evaluation tool as a condition of work (like BAs for truck drivers)
  - Label uses are safe; use only labeled products
  - Normal biomarker levels = safe biomarker levels
  - Validate biomarkers during label use
  - Require and record annual physical examinations as a confidential record; keep workforce data (epidemiological records) in coded form for health research



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