

# Herbicide and Other Chemical Toxicology

*regulatory foundations for chemical use*

Bob Krieger, Ph. D.

Personal Chemical Exposure Program

Department of Entomology

UC Riverside

# Our Living Chemical World

Known	22,000,000+
– Commercial Products	100,000
• “Toxic Substances”	50,000
– Pesticides	1,000
– Products	13,000

--not a body burden!

# Chemical Risk: Dose/Exposure

*Experimental*

*Human Exposure*

Hazard

Use

Dose-Response

Exposure

Risk Assessment

Management

Communication

# *Toxicity*

## LD50, LOAEL, NOAEL

Lethal Dosage 50% population LD50	Low Observed Adverse Effect Level (threshold)	No Observed Adverse Effect Level
Death	Organs Reproduction Growth	No effects in most sensitive species

## Toxicology Profile: Imazapyr

- Skin, eye and respiratory irritant.

ORL-RAT LD50 > 5000 mg kg<sup>-1</sup>

ORL-MUS LD50 > 2000 mg kg<sup>-1</sup>

SKN-RBT LD50 > 2000 mg kg<sup>-1</sup>

ORL-QAL LD50 > 2150 mg kg<sup>-1</sup>

ORL-DCK LD50 > 2150 mg kg<sup>-1</sup>

- *From the MSDS*

# Product Profile: Imazapyr

**Chopper®:** imazapyr (22.6%), isopropylamine (5.4%), and other inert ingredients (72%)

**Arsenal®:** imazapyr (27.6%), and inert ingredients (72.4%)

**Chopper® RTU:** isopropylamine salt of imazapyr (3.6%), propylene glycol (30%), isopropanol (5.0%), and other inert ingredients (61.4%)

## Toxicity Profile: Glyphosate

- LD50 (oral rat)                      more than 2,000 mg/kg
- LOAEL (rabbit dermal)                      5,000 mg/kg
- NOAEL (rabbit dermal)                      1,000 mg/kg

## Toxicity Issues: Glyphosate

- Effectiveness
- Formulations
- Aquamaster 63.8% vs Roundup Pro 41%



## Toxicity Issues: Triclopyr

- Clothing retains residue
- Poor skin absorption
- No body burden
- Plant death

## Toxicity Profile: Triclopyr

- LD50 (rat, oral) 630-729 mg/kg  
(dermal) more than 2,000 mg/kg
- LOAEL (subchronic, oral) 20 mg/kg
- NOAEL (subchronic, oral) 5 mg/kg

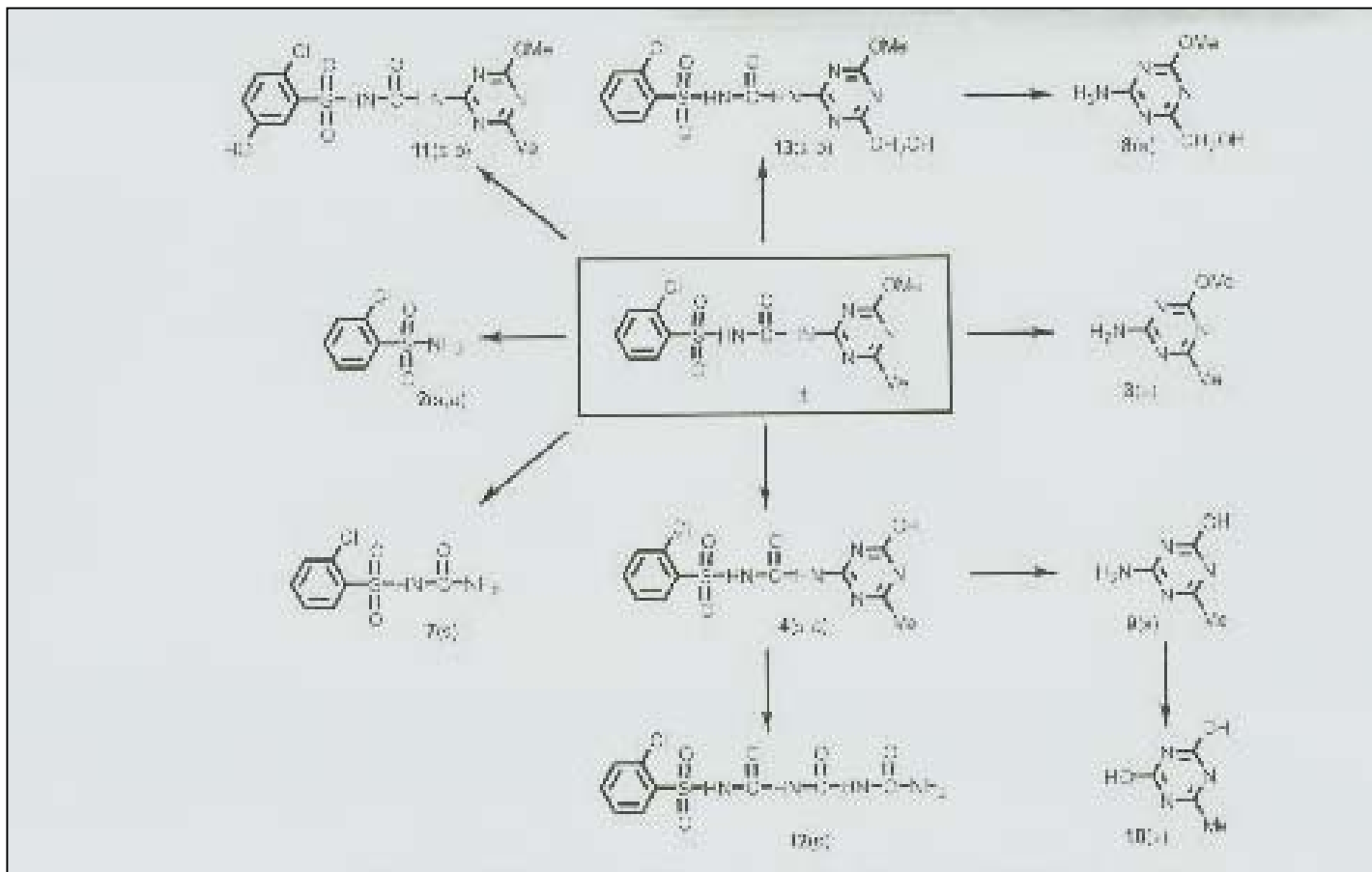
## Toxicity Profile: Clopyralid

- **Carcinogenicity:** no evidence in a 2 year feeding study in mice at 2,000 mg/kg (highest dose tested)
- **Developmental:** no evidence in rats or rabbits at 250 mg/kg (highest dose tested).
- **Reproduction:** No effects in a two generation study in rats at 1500 mg/kg (highest dose tested)

# Clopyralid Environmental Persistence

- Mobile in soil
- Adsorption reduces water levels
- Degradation by microorganisms
- Found above 2 feet in soil
- Half-life in compost
  - 6 to 66 days
  - Average 22 days

# Chlorsulfuron Breakdown (not a burden!)



# Toxicity Profile: 2, 4-D

- LD50 800-2000 mg/kg
- LOAEL 60 mg/kg kidney  
300 mg/kg testes
- NOAEL 15 mg/kg kidney  
100 mg/kg testes

## 2,4-D Reference Dose

- NOAEL 15 mg/kg kidney
- Uncertainty Factors
  - Species: animal to human (0.1) 1.5 mg/kg
  - Person-to-person (0.1) 0.15 mg/kg

$$\text{RfD} = \text{NOAEL} \times 0.1 \times 0.1$$

# ***Dandelions!***

***APPLICATION OF THE MOUSE LIMB  
MICROMAS ASSAY FOR SCREENING  
WHOLE-FOODS EXTRACTS.***

***B Tornesi<sup>1</sup>, GD Charles<sup>1</sup>, JL Mattsson<sup>2</sup>,  
E.W. Carney<sup>1</sup> and BB Gollapudi<sup>1</sup>.***

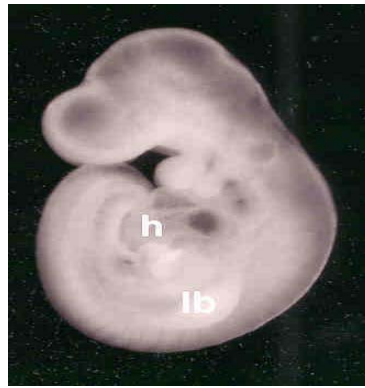
***<sup>1</sup>Toxicology & Environmental Research  
& Consulting, The Dow Chemical Co.,  
Midland MI, USA; <sup>2</sup>Global Toxicology,  
Dow AgroSciences, Indianapolis IN,  
USA.***

Presented at 2002 Annual Meeting of the Teratology Society

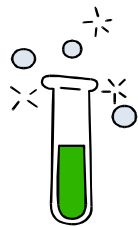




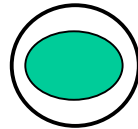
**Gestation day 11**



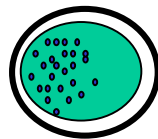
**Day 11 embryo**



**Limb-buds are pooled and trypsinized**



**Plate undifferentiated cells**

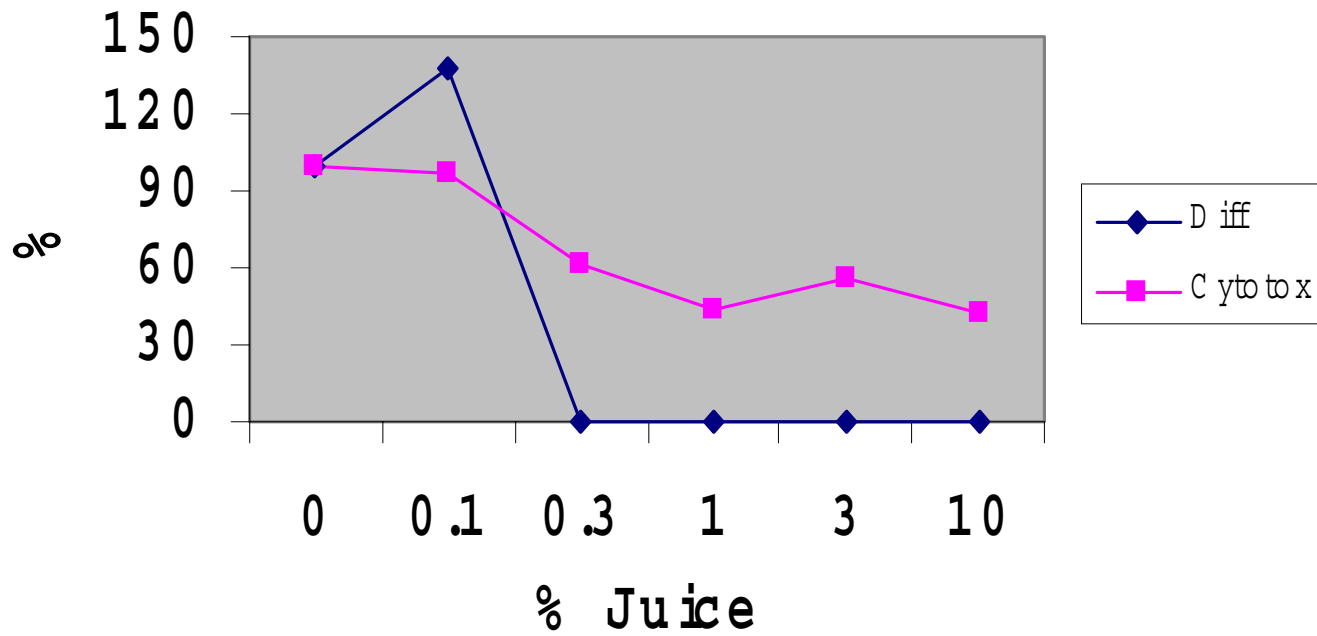


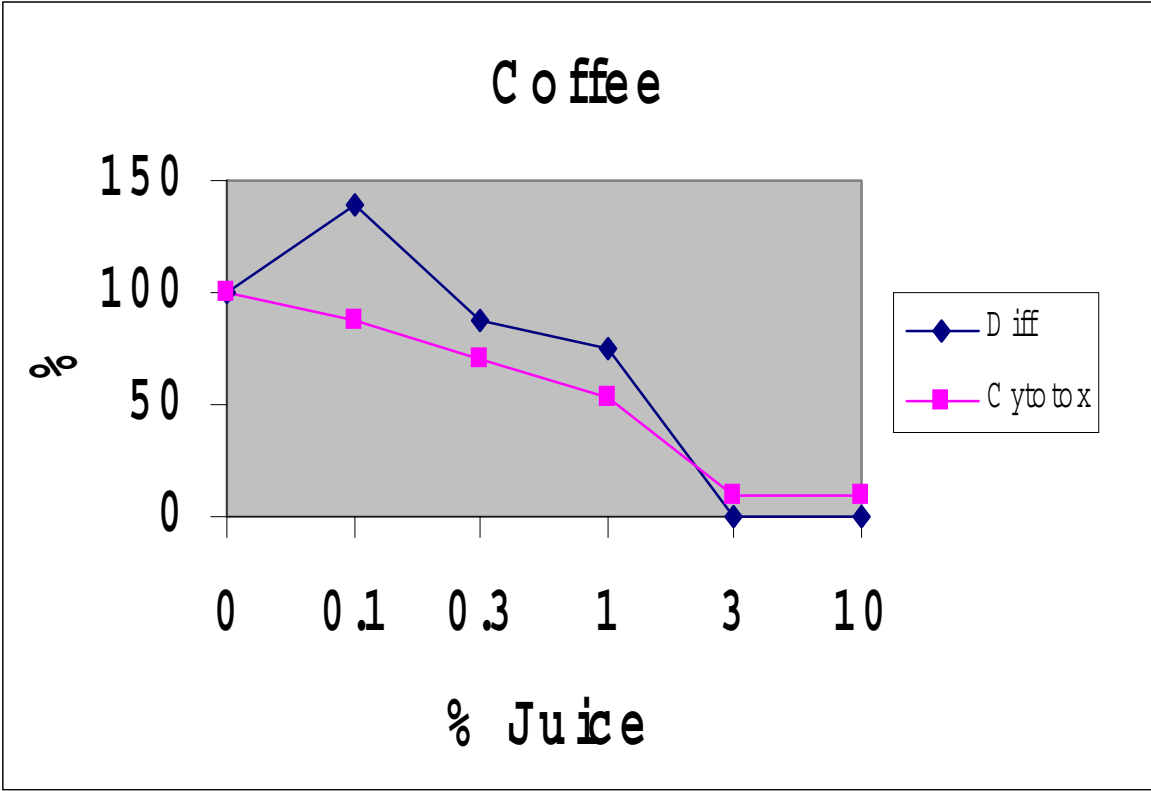
**5 days later**

**Table:** Effect of selected plant test materials on the differentiation and proliferation of micromass cultures of embryonic mouse limb buds.

<b>V e g e t a b l e</b>	<b>R A T I O d i f f / c y t o x</b>	<b>T e r a t o g e n i c R e s p o n s e</b>
R e t i n o i c A c i d	0 . 0 2	+++
S o y B e a n s	0 . 2 0	++
P e a P o d s	0 . 3 0	++
D a n d e l i o n s t e m s & f l o w e r s	0 . 3 0	++
D a n d e l i o n l e a v e s	0 . 4 0	++
B r o c c o l i	0 . 5 0	(+)
G a r l i c	0 . 9 5	-
C o r n	0 . 8 0	-
C a r r o t s	1 . 7 0	-
A s p a r a g u s	1 . 0 5	-
B e a n S p r o u t s	0 . 7 0	-
S p i n a c h	0 . 9 0	-
C o f f e e	2 . 2 5	-
L e t t u c e	N / C	N / C
I n j u r e d L e t t u c e	N / C	N / C
T o m a t o	N / C	N / C
I n j u r e d T o m a t o	N / C	N / C
C o r n	1 . 9 5	-

# Dandelion Leaves





# Minimizing Your Pesticide Exposures

- Use good judgment
- Know your labels
- Clean clothing
- Work gloves
- Shower or bathe promptly

Chemical exposures—you can't live without 'em!

- Chemical exposure is essential
- Exposure can be measured
- Exposure is not a disease
  
- Dose is the chemical part of risk
- Risk reduction is an ongoing process!