

Recognizing Illnesses Related to Forestry Herbicides

Michael O'Malley, M.D., M.P.H.
 University of California, Davis
 California Department of Pesticide
 Regulation

Herbicide Community Education Project

- Public meetings 1994-1996, **highlighted provider communication problems**
- CRIBH presentation June, 1999
- Public meetings 1999, 2000
- Written material completed 2001
- Online material completed 2002
- Updated material on archived superfund sites
- July, 2002 - museum artifact preservatives

Herbicides versus other pesticides

- Pesticides - broad group of both use and structural categories
- Herbicides with relatively specific effects on plant biochemistry typically have low mammalian toxicity.
 - Inhibiting photosynthetic electron transport, inhibiting of - 5-enolpyruvylshikimate-3-phosphate-synthase (EPSPS) or mimic the effect of plant growth hormones
- Others, such as the bipiridyls diquat and paraquat, are reactive chemicals that interact in a non-specific way with many types of living tissue.

Forestry Herbicide Interest Groups

Tribal groups: California Indian Basketweavers' Association, Yurok, Karuk, Hupa, Pitt River, Lake & Mendocino tribes, Miwok

NGOs: Californians for Alternatives to Toxics, other environmental groups

Government Agencies: Forest service, EPA, USGS, USDA, County Agriculture in Humboldt/Del Norte, Pesticide Regulation, Forestry, OEHHA, Health Services

Companies: Pacific, Simpson, Barnum, etc

Compound	Applica-tions	Pounds	Acres
Atrazine	44	3,830	1,874
2,4-D, related compounds	154	18,382	8,766
Glyphosate	243	30,776	25,641
Hexazinone	218	47,022	11,783
Octylphenoxypoly ethoxyethanol (surfactant)	110	14,454	16,440
Petroleum hydrocarbons	93	26,834	6,875
Polyoxyethylene mixed fatty acid ester			
Sulfometuron methyl	52	325	3,447
Triclopyr	469	81,016	37,413
Reported forestry total	1,908	230,948	

Reforestation



- Principal use of herbicides is in reforestation after forest fires

Forestry Herbicide Applications



- Some applications are made by air
- Helicopter application using large bucket of herbicide

Hand applications



- Typical applications using hand spraying equipment
- Post-fire applications to eliminate understory plants that compete for growth resources with newly planted conifer seedlings

Backpack sprayers



- Hand application commonly involves use of back sprayers - these pose potential risk to applicator when they leak

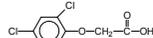
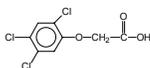
Exposure to basket makers

- Most pesticide residue exposure occurs through skin contact
- Potential ingestion of residue in making baskets



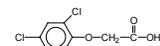
Phenoxy herbicides

- Function as hormonal growth inhibitor (auxins) - broadleaf weeds
- 2,4-D (chlorination of phenol) & 2,4,5-T (hydroxylation of tetrachlorophenol) made by different manufacturing processes
 - 2,3,7,8 TCDD dioxin contamination limited to 2,4,5-T products
- 375-666 mg/kg rat oral LD50; Mild acute skin irritation, myotonia with ingestion, ? Peripheral neuropathy



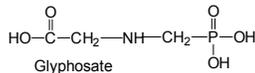
2,4-D chronic risks

- Bioassays have shown limited evidence for carcinogenicity of 2,4-D in animals (astrocytomas in male rats at high doses only, and several completely negative studies).
- Case-control studies in the USA have however, found associations between frequent use of 2,4-D and non-Hodgkin lymphoma
- No documented environmental risk



Glyphosate

- Inhibits 5-enolpyruvylshikimate-3-phosphate-synthase (EPSPS) - functions by preventing synthesis of the aromatic amino acids, tyrosine and phenylalanine. Mammals obtain aromatic amino acids from dietary sources: very low systemic toxicity for humans
- Non-selective in its effect on plant biochemistry - range of action similar to that of paraquat.
- Ivy-like plants with thick, waxy leaf surfaces are relatively resistant to glyphosate because they do not permit translocation of salts or polar compounds
- Eye/skin irritation in applicators; sensitization to thiazolin preservative in formula

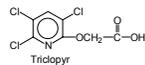


Glyphosate Illness Experience

- 557 possible-definite cases 1982-1995
- 478 cases (85.8%) handler cases, typically involving topical symptoms.
- Literature report sensitization

Triclopyr

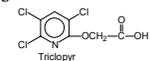
- Functions as auxin, similar to 2,4-D
- Premature “fall-foliage” - high concentrations
- Rat oral LD50: 630 to 729 mg/kg, over 2000 mg/kg for ester, amine formulatins
- 8 cases topical irritation (eye/skin) 1982-1995
- 65 day post application dissipation



Red forest following triclopyr use

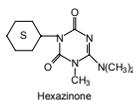


- Environmental effects of triclopyr
- Material is an auxin, similar to phenoxy herbicides - “premature aging of leaves”



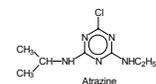
Hexazinone

- Inhibits photosynthesis in targetplants
- Acute toxicity - 1690 mg/kg rats
- 2 applicator cases 1982-1995: bronchitis and urticaria
- Cancer: negative rat study up to 500 mg/kg/day; mouse liver adenomas at ≥ 300 mg/kg/day



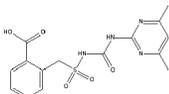
Atrazine

- Pre-emergent triazine herbicide used for control of broadleaf and grassy weeds, right-of-way uses
- LD50 - 3090 mg/kg in rats, mild skin irritant; mammary tumors in studies at 1000 ppm in diet, not at 500 ppm
- Single applicator eye irritation case 1982-1995



Sulfometuron

- Used to control woody tree species in forestry applications
- Oral rat LD50 > 5000 mg/kg; not oncogenic in feeding studies
- 3 applicator cases, 1 drift case with irritant eye/respiratory symptoms



Environmental sampling



- Sampling for residue in national forest - understory plants
- Watershed sampling
- Residue in fish

Representative Environmental Sampling

- Klamath River drainage, 4/23/2000
- Maximum positive: triclopyr 1.06 ppb, 2,4-D 0.584 ppb
- Non-detectable samples 4/24/2000
- 4/25/2000 Maximum positive: triclopyr 0.122 ppb, 2,4-D 0.103 ppb
- 4/27/2002: triclopyr 0.388 ppb, 2,4-D 0.232 - **increased runoff because of rain**

Comparison to residue tolerances

Chemical	Peak ppm	Range ppm	Commodity	Tolerance
Atrazine	NA	0.02-15	Wheat	0.25
2,4-D	NA	0.05 - 1000	Fruits/berries	0.1
Glyphosate	10	0.1-200	Citrus	0.5
			Tree nuts	1
Hexazinone	10	0.1-10.0	Blueberries	0.2
			Pineapples	0.5
Sulfometuron methyl	NA	0.05 - 20.0	Wheat	0.1
Triclopyr	0.7	0.01-500	Rice	0.3

Evaluation of Cancer Rates

- Comparison of Humboldt/Del Norte cancer rates with California rates
- Elevated rates smoking related cancer
- Short-term elevation non-Hodgkin's lymphoma
- Link to smoking, diabetes, herbicide use
- No data available on herbicide exposure of individuals

Questions about Archived Superfund Sites

- Tribal staff in Hoopa Valley raised issues regarding potential exposures to residues of heavy metals, documented as present in soil samples taken by U.S. EPA, including lead and arsenic.
- Contaminated soil removed to clean up site
- Other sites reviewed

Preservatives in Museum Artifacts

- Repatriation of antiquities law created dilemma regarding return of baskets other cultural materials
- Surveys by curators at Smithsonian revealed history of treatment with mercury and arsenic salts, more recently synthetic insecticides, fumigants
- ? Unknown whether risk for any California tribes

Sample of Post-test

- OP questions
- Approximate range of toxicity, as measured by single dose rodent oral LD50's
- a) 3 mg/kg - 1500 mg/kg
- b) 25 mg/kg - 550 mg/kg
- c) 75 mg/kg - 925 mg/kg
- d) 100 mg/kg - 1200 mg/kg

Pesticide Illness Reporting Form

- **Means of documenting cases related to herbicides, insecticides, and other pesticides--including sanitizers and disinfectants**
 - Reporting form developed by Office of Environmental Health Hazard Assessment

Distribution of Training Material

- Up to 50 printed copies will be available on request from Department of Pesticide Regulation (DPR)
- Copies will be available at no charge from the internet: **WWW.CDPR.CA.GOV**
- **4 hours Continuing Medical Education credit available at minimal cost from UC Davis Medical Center web site**