

Criteria for Selecting Pest Control Products & Methods

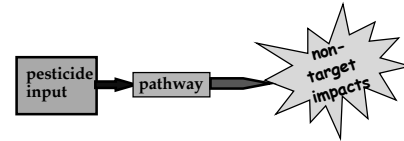
Lois Levitan, Ph.D.
Environmental Risk Analysis Program
Center for the Environment and
Department of Communication
Cornell University
Ithaca NY, USA 14853

Prepared for the IPM Technical Advisory Committee, County of Santa Clara, California, April 1, 2003 Quarterly Meeting (revised for Aug 18, 2003 Mtg)



Objectives

- Approaches to making "least risk" choices
- Proposed system for County of Santa Clara, CA

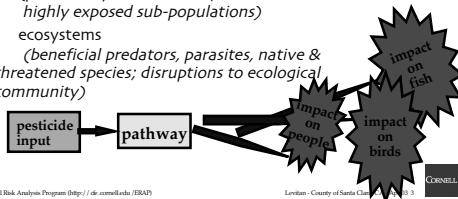


Types of Pesticide Risks & Impacts

Impacts on non-target biota
direct & indirect
lethal and sub-lethal
acute (right away) & chronic (over long time)

Consequences for human health & wildlife
(particularly vulnerable &/or highly exposed sub-populations)
ecosystems

(beneficial predators, parasites, native & threatened species; disruptions to ecological community)

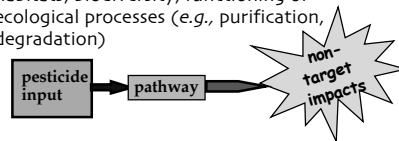


Types of Pesticide Risks & Impacts

Impacts on environmental media

air
soil
water

Consequences for ecological niches, habitats, biodiversity, functioning of ecological processes (e.g., purification, degradation)



Types of Pesticide Risks & Impacts

- Remediation & other costs paid by society
- Pesticide residues on food, in water, soil, air
- Pest resistance to pest controls
- Pesticide in-effective: Risk of disease, or development of dangerous conditions
- Cost of pest damage < \$\$ cost of pest control
- Resource degradation from use/non-use of pesticide (e.g., methyl bromide → ozone depletion; soil tilling → erosion & sedimentation)

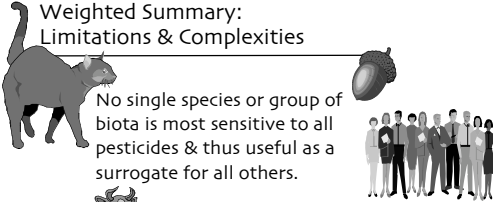


Methods for Making Pest Control Choices &/ or Creating Hazard Categories

- Weighted summary of relative risks, leading to a "risk ranking"
- Screen or Checklist
- Logical Chain of Decision Rules



Weighted Summary: Limitations & Complexities




No single species or group of biota is most sensitive to all pesticides & thus useful as a surrogate for all others.

What endpoints? Acute lethal toxicity, sub-lethal effects that affect ability to survive (e.g., feeding avoidance & other behavioral, reproductive), loss of habitat / food source?

Do not reflect situation-specific risks/risk mitigations

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levittan - County of Santa Clara, CA - Apr 03 7

Comparison of "most hazardous" from 3 "Pesticide Risk Indicators":



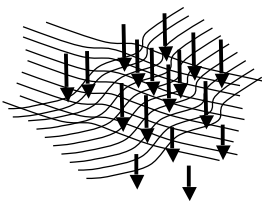
Pesticides from List of Top 30 Chemicals, ranked by Shannon et al. Screening System, Not Weighted by Usage (1997)		Highest-Hazard Pesticides, ranked by the UC Environmental Health Policy Program (Pease et al. 1996)		Highest Environmental Impact Quotient (EQ) values for pesticides (Kovach et al. 1992)	
Rank	Pesticide	Rank	Pesticide	Rank	Pesticide
1	terbufos	1	methomyl	1	disulfoton
2	trifluralin	2	aldicarb	2	parathion
3	hexachlorobenzene	3	carbofuran	3	propoxur
4	anthracene	4	2, 4-D (+ salts)	4	oxydemeton-methyl
5	chlorothalonil	5	mevinphos	5	fenamiphos
6	2, 4-D	6	dimethoate	6	dimethoate
7	1,3-dichloropropene	7	trifluralin	7	paraquat

Only 2,4-D, trifluralin & dimethoate are on more than one list

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levittan - County of Santa Clara, CA - Apr 03 8

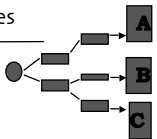
Checklist or Screening Tool

- Removes certain options from consideration, based on a specified property, or rule
- Mitigating factors notwithstanding...



Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levittan - County of Santa Clara, CA - Apr 03 9

Logical Chain of Decision Rules

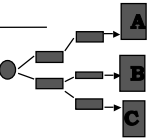


- Similar to flow chart or dichotomous key
- Series of algorithms creates knowledge-based system that provides info to solve complex problems
- Answers to one tier of questions direct decision-maker to different sets of next questions
- Responsive to situation-specific factors

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levittan - County of Santa Clara, CA - Apr 03 10

Logical Chain of Decision Rules

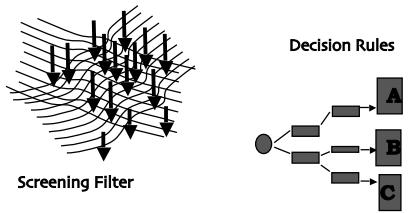
Sensitive to situation-specifics



- Seasonal & diurnal timing of intervention
- Application method: aerial, subsurface, spot ...
- Pesticide formulation type: liquid, dust., containerized bait...
- Climate & weather conditions: rainy or dry season, wind
- Soil & soil-pesticide interactions
- Protective standards for specific locations
- Relative risk of available options

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levittan - County of Santa Clara, CA - Apr 03 11

Recommend: Combination of Screen & Decision Rules to develop "Approved List of Pesticides"




Screening Filter


Decision Rules

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levittan - County of Santa Clara, CA - Apr 03 12

Proposed Selection System for County of Santa Clara, CA




- **Conceptual Framework:**
Integrated Pest Management and Pesticide Use (Ordinance NS-517.70)
- **Policy Objective:**
"eliminate or reduce pesticide applications on County property to the maximum extent feasible."
- **Inference:**
If risks are less or equal (\leq) & efficacy is greater or equal (\geq), use non-chemical pest controls




Environmental Risk Analysis Program (<http://dk.cornell.edu/EIRAP>)

Levitan - County of Santa Clara, CA - Apr 03 13




Proposed Selection System for County of Santa Clara, CA




- Assessment endpoints (a.k.a. — optimization criteria):
 - a. health & safety of County employees
 - b. health & safety of general public (consideration of sub-populations)
 - c. the environment [undefined]
 - d. water quality
 - e. sustainable solutions for pest control
 - f. adherence to IPM principles

(Per IPM Ordinance NS 517.70)




Environmental Risk Analysis Program (<http://dk.cornell.edu/EIRAP>)

Levitan - County of Santa Clara, CA - Apr 03 14




Proposed Selection System for County of Santa Clara, CA



Sustainable solutions for pest control


Infer that should optimize for:
Pest Control that

- does not make the pest situation worse (e.g., as might happen if weed seeds are allowed to proliferate)
- does not increase pest resistance
- does not adversely affect non-renewable & other precious resources (i.e., this criteria selects against mechanized controls, due to fossil fuel use)




Environmental Risk Analysis Program (<http://dk.cornell.edu/EIRAP>)

Levitan - County of Santa Clara, CA - Apr 03 15



Proposed Selection System for County of Santa Clara, CA




Adherence to IPM principles
(Per IPM Ordinance NS 517.70)

- Surveillance for pests
- Combine biological control, cultural practices, mechanical and physical tools, & chemicals to minimize pesticide usage
- Use least hazardous pesticides only as a last resort for controlling pests


*Inconsistent with sustainability objectives?
Recommended approach:*


"Least risk product/method with sufficient efficacy."



Environmental Risk Analysis Program (<http://dk.cornell.edu/EIRAP>)


Levitan - County of Santa Clara, CA - Apr 03 14



 **What is Risk?**


risk = f (hazard, exposure)

"risk" is a function of the ability to cause harm (hazard) & the chance of being in harm's way (exposure)

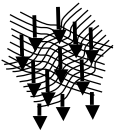


Environmental Risk Analysis Program (<http://dk.cornell.edu/EIRAP>)


Levitan - County of Santa Clara, CA - Apr 03 17



Screen for Hazards & Exposure
(Per IPM Ordinance NS 517.70)




- EPA Toxicity Category I or II
- Known carcinogen, reproductive or developmental toxin, per CA Safe Drinking Water & Toxic Enforcement Act of 1986
- Pesticide on CA groundwater protection list
- Organophosphate chemicals
- Carbamate chemicals
- Known, probable or possible human carcinogen, based on US EPA standards
- "significant hazard to human health or the environment," *per unstated criteria*, if so designated by US EPA or CA EPA

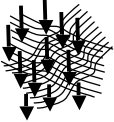


Environmental Risk Analysis Program (<http://dk.cornell.edu/EIRAP>)

Levitan - County of Santa Clara, CA - Apr 03 14




Recommend:
Limit Additional Screening Criteria



- Retain more options
- Resistance increases as options decrease (especially with more highly targeted products)
- Use decision criteria & approvals to limit **exposure** to hazards, e.g., by **reducing area** where used (spot applications, designating key sites), **movement from target area** (non-volatile formulations, restrict usage where runoff & leaching are not impeded)

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levitan - County of Santa Clara, CA - Apr 03 19


**Ecological, Systems Approach
 Integrated Pest Management**



- Design & planning to avoid pest problems
- Pro-active cultural practices & materials protective against pest outbreaks
- Action threshold for intervention consider raising bar to account for environmental costs as well as economic
- Counter build-up of resistance with broad array of control options

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levitan - County of Santa Clara, CA - Apr 03 20


**Ecological, Systems Approach
 Integrated Pest Management:
 Identifying Options**



- When intervention is called for, optimize for most sustainable, most benign (least risk) improving ecological balance decreasing future pest problems
- Evaluate efficacy for near-term control for long-term reduction of pest problem(s)
- Identify low risk options for responding to problem Use EPA lists of Reduced Risk, biopesticides, microbials; products recommended as consistent with IPM

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levitan - County of Santa Clara, CA - Apr 03 21

**Ecological, Systems Approach
 Integrated Pest Management:
 Reducing Hazards**



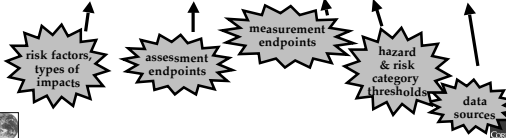
- Reduce use & access to products
 - that would create serious hazard if exposed through malfeasance, accident, or ignorance
 - that bioaccumulate or poison higher on food chain
- High volume materials require more sensitive hazard criteria
- Hazard differences to various sub-populations (e.g., infants, children, pregnant women immune-compromised)
- Compare pesticide hazard data with criteria for hazard thresholds (see Sources of Information about Pesticides and their Non-Target Impacts. Levitan 2003)
- Differentiate between predictive & empirical data

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levitan - County of Santa Clara, CA - Apr 03 22

Criteria & Indicator Matrix

Criteria & Indicator Matrix of Pesticide Impacts

beneficials	adult acute toxicity	LC ₅₀	<2 µg/bee	Atkins'81
phytotoxicity	% seedling emergency	EC ₅₀	<10 mg/kg	Windeatt
persistence	half-life	days	> 180	Howard'91



Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levitan - County of Santa Clara, CA - Apr 03 23

Indicators of Pesticide Impacts/Risk

- Determine if appropriate data exist for measurement endpoints
- Evaluate choice of selected measurement endpoints as indicators of assessment endpoints
- If selected assessment endpoints are meaningful under particular situation-specific conditions
- If there is doubt when evaluating specific numerical values, go to initial source to understand assumptions

Environmental Risk Analysis Program (http://dk.cornell.edu/ERAP) Levitan - County of Santa Clara, CA - Apr 03 24

Ecological, Systems Approach Integrated Pest Management Reducing Exposure



- Signage Requirements
IPM Ordinance, Section B2-7, mandates warning signage to limit exposure of recreating public post-application
Is signage sufficiently protective of applicators, other staff?
- Limit Uses where migration is more likely (e.g., by leaching, runoff, drift, volatility)
 - Use resources of Pesticide Drift Task Force
 - Test assumptions of predictive models for runoff & leaching vs. situation-appropriate empirical evidence (e.g., difference between macropore & micropore flow)
 - CA DPR "ROG emissions potential factor" volatility index (see *Methodology & Summary*, both 2002)



Environmental Risk Analysis Program (<http://dk.cornell.edu/ERAP>)

Levitan - County of Santa Clara, CA - Apr 03 25



Ecological, Systems Approach Integrated Pest Management Reducing Exposure



- Containerized formulations (e.g., baits, pre-mixes/briquets that do not expose applicator to dust)
- Formulations that minimize volatility (e.g., avoid pressurized gas, liquid, spray fogger, dust. Choose dust or soluble powder, wettable powder, dry flowable, flowable concentrate, granular or flake, oil)
- Application equipment that recycles excess
- Protective clothing and equipment
- Spot applications rather than "broadcasting"
 - preferred whenever it is sufficiently effective



Environmental Risk Analysis Program (<http://dk.cornell.edu/ERAP>)

Levitan - County of Santa Clara, CA - Apr 03 26



Ecological, Systems Approach Integrated Pest Management Reducing Exposure



- Use Geographic Information Systems (GIS) to identify areas where:
 - usage is higher (see maps)
 - mobility is not impeded (e.g., pavement)
 - natural areas should not be disturbed by pest control interventions (designate categories of intervention criteria)
 - risk is higher or higher standards for pest management are called for (e.g., where pests are greater danger to human health and safety)
 - soils, slopes, setbacks

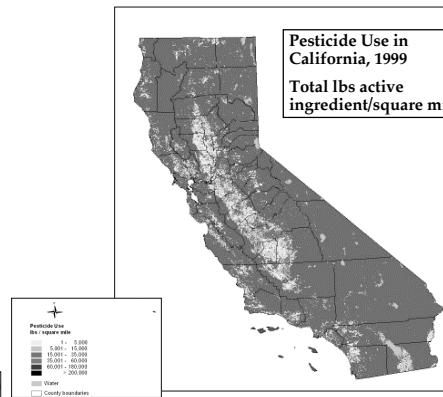


Environmental Risk Analysis Program (<http://dk.cornell.edu/ERAP>)

Levitan - County of Santa Clara, CA - Apr 03 27



Pesticide Use in California, 1999 Total lbs active ingredient/square mile



Environmental Risk Analysis Program (<http://dk.cornell.edu/ERAP>)

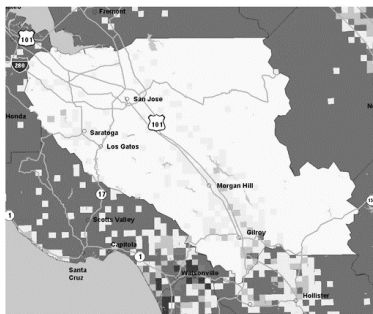
Levitan - County of Santa Clara, CA - Apr 03 28



Reported Agricultural Pesticide Use In Santa Clara County Total Pounds of Active Ingredient Applied Per Square Mile



- Pesticide Use lbs / square mile**
- 1 - 5,000
 - 5,001 - 15,000
 - 15,001 - 35,000
 - 35,001 - 60,000
 - 60,001 - 180,000
 - > 200,000
- Legend also includes: Highways, Water, Santa Clara County, and Cities.



Data Sources:
Cal EPA DPR Pesticide Use Report 1999
Public Land Survey Water and County Coverages
Produced with
ESRI ARCVIEW 3.2a software



Environmental Risk Analysis Program (<http://dk.cornell.edu/ERAP>)

Levitan - County of Santa Clara, CA - Apr 03 29

