

# NCC/STMA Fall Forum & General Membership Meeting 12/1/2010

## Blankinship & Associates – Fate of Pesticides in the Environment

### The Fate of Pesticides in the Environment

NCC/STMA Fall Forum &  
General Membership Meeting  
December 1, 2010



Michael Blankinship

**Blankinship & Associates Inc.**  
Agricultural & Environmental  
Scientists & Engineers

s-block		d-block										p-block						s-block																																																																												
1	2	Transition Metals										Non-Metals						18	VIIIA																																																																											
IA	IIA											IIIA	IVA	VA	VIA	VIIA																																																																														
Atomic #	Atomic #	Atomic #										Atomic #						Atomic #	Atomic #																																																																											
Symbol	Symbol	Symbol										Symbol						Symbol	Symbol																																																																											
1 H 1.0094	2 He 4.00260	3 Li 6.941	4 Be 9.0122	5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179	11 Na 22.990	12 Mg 24.305	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948	19 K 39.098	20 Ca 40.08	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80	37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc 98	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.29	55 Cs 132.91	56 Ba 137.33	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po 209	85 At (210)	86 Rn (222)	87 Fr (223)	88 Ra (226)	89 Unq (261)	90 Unp (262)	91 Unh (263)	92 Uns (264)	93 Uno (265)	94 Une (266)	95 Uun (267)
		Metals																Phases																																																																												
																		Solid																																																																												
																		Liquid																																																																												
																		Gas																																																																												
Rare Earth Elements		Lanthanide Series										Actinide Series																																																																																		
		57	58	59	60	61	62	63	64	65	66	67	68	69	70	71																																																																														
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu																																																																														
		138.91	140.12	140.91	144.24	(145)	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.04	174.97																																																																														
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr																																																																														
		227.03	232.04	231.04	238.03	(237.05)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(260)																																																																														

$$66. \quad 9x^2 - 6x + 37 = 0$$

$$a = 9, b = -6, c = 37$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-(-6) \pm \sqrt{(-6)^2 - 4(9)(37)}}{2(9)}$$

$$x = \frac{6 \pm \sqrt{36 - 1332}}{18} = \frac{6 \pm \sqrt{-1296}}{18}$$

$$= \frac{6 \pm 36i}{18} = \frac{1 \pm 6i}{3} = \frac{1}{3} \pm 2i$$

### Today's Talk

- Turf's Perception
- The Risk Myth
- Case Study
- Tools, Tools and More Tools
- Golf & Water Quality



# NCC/STMA Fall Forum & General Membership Meeting 12/1/2010 Blankinship & Associates – Fate of Pesticides in the Environment

**Perception Is Reality**

**Promising foresight in CEQA TI IFWI are often undermined by improper implementation.**

**PROTECTING THE AQUATIC ENVIRONMENT FROM THE EFFECTS OF GOLF COURSES**

By Richard D. Klein  
Community & Environmental Defense Services  
1111 California Street  
Emeryville, CA 94608  
(415) 434-4402  
r.klein@ceds.com  
www.ceds.org  
November 2008

**Perception Is Reality**

Beyond Pesticides Daily News Blog

**Aquatic Organisms Harmed by Golf Course Pesticides**

(Beyond Pesticides, May 5, 2008) A new study indicates that some pesticides applied to golf courses in the Precambrian Shield of central Ontario may have an impact on aquatic organisms in adjacent waterbodies. The study is published in the April issue of *Environmental Toxicology and Chemistry*.

Golf courses affect the environment by altering the habitat through the release of nutrients and pesticides. The Precambrian Shield region of central Ontario, Canada, a major recreational area, is especially susceptible to the impacts of golf courses as a result of the geology and hydrology of the region. The Shield area is characterized by many lakes, rivers, and streams. Golf courses in this area typically place turf on top of a sand base which allows chemicals used on the courses to migrate into surrounding bodies of water.

**Cosmetic Use of Lawn Chemicals Banned in Ontario**

(Beyond Pesticides, April 23, 2008) Ontario is moving to reduce exposure to lawn chemicals by banning the sale and cosmetic use of pesticides. Legislation to be introduced today would make Ontario's pesticide laws among the toughest in North America. It would also reduce a variety of products that have been in place across the province. Studies by public health experts are showing growing evidence of the potential health risk of pesticides, particularly for children. The ban would likely take effect next spring. It would not affect pesticides used for farming or forestry. Golf courses would still be able to use pesticides, but must meet certain conditions to minimize environmental impacts. Pesticides would still be allowed for control of mosquitoes and other insects deemed to represent a health threat.

"Our generation is becoming more and more aware of the potential risks in our environment, not only to our health, but to our children's health. That's why we're taking action on behalf of the next generation of Ontarians, and reducing their exposure to chemicals," said Thomas Siskin, Minister.

"Many municipalities have already shown leadership in banning or restricting cosmetic use pesticides. We're ensuring that protection for all families wherever they live," said Environment Minister John Gerretsen.

**Perception Is Reality**

**GOLF DIGEST May 2008**

"The most important article we've ever published"

**Perception Is Reality**

NCC/STMA Fall Forum & General Membership Meeting 12/1/2010  
Blankinship & Associates – Fate of Pesticides in the Environment

### Perception Is Reality

9

### Perception Is Reality

- **Golf Digest:** Would you say that golf-course pesticide use in the United States today is not safe?
- **Jay Feldman\*:** I would say that, yes.

\* Co-founder: Beyond Pesticides

10

### Perception Is Reality

“So if a kid was drinking a lot of juice, say, which kids do, and playing a lot of golf, at the end of the day that kid is getting a high toxic load.”

Jay Feldman in Golf Digest May 2008

11

### The Risk Myth

$$\text{Risk} = \text{Toxicity} \times \text{Exposure}$$

12

### The Risk Myth: Toxicity Terms

- **LC<sub>50</sub>**
  - Lethal Concentration that kills 50% of a test population
  - Typically expressed in mg/L
- **LD<sub>50</sub>**
  - Lethal Dose that kills 50% of a test population
  - Typically expressed in mg/Kg of animal body weight

13

### The Risk Myth: Toxicity Data

Product Name	Active Ingredient	LC50	
		mg/L	Species
Various	Glyphosate IPA Salt	79 -120	Fathead Minnow
Nautique	Copper Carbonate	2 to 21	Fathead Minnow
Sonar	Fluridone	12	Rainbow Trout
Reward	Diquat Dibromide	12	Rainbow Trout
Copper Sulfate	Copper Sulfate Pentahydrate	1	Fathead Minnow

### The Risk Myth: Exposure

- Dermal (Absorption)
- Oral (Ingestion)
- Inhalation (Inhalation)
- But, what happens to the chemical on the way to the receptor.....?

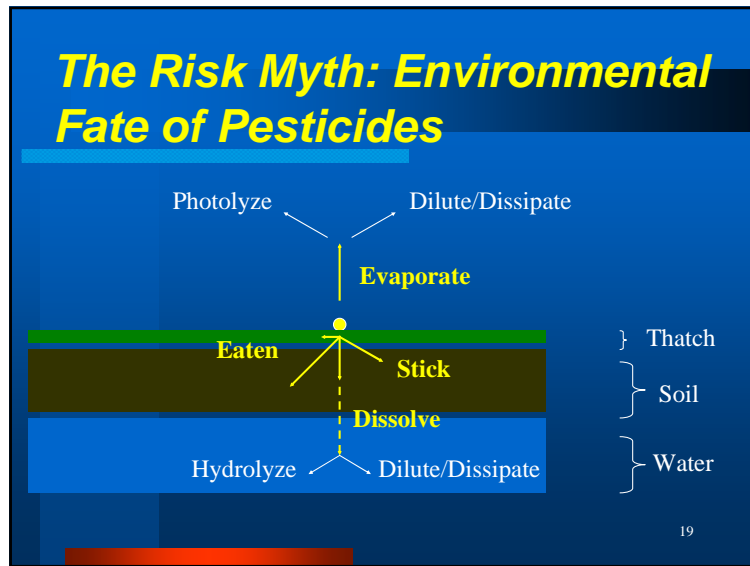
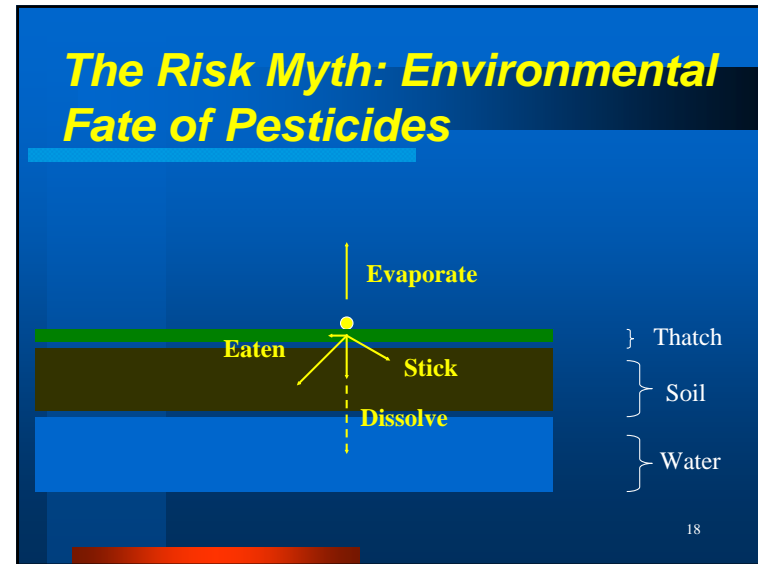
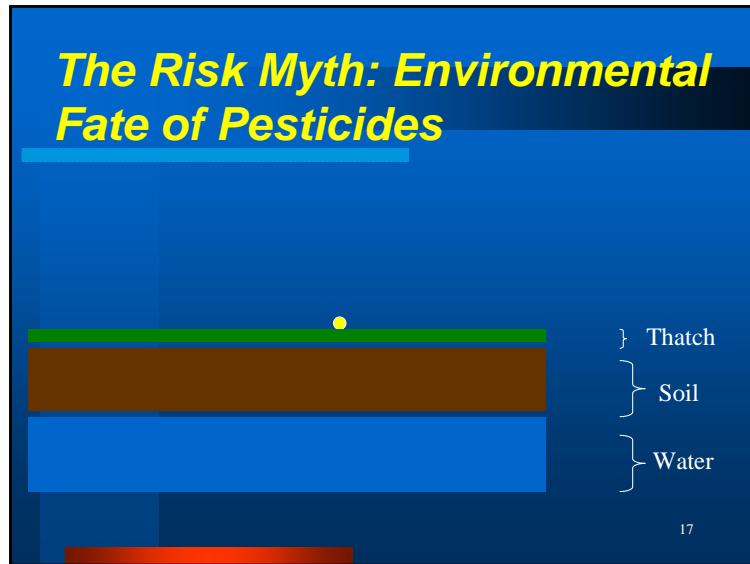
15

### The Risk Myth: Exposure

- But, what happens to the chemical on the way to the receptor.....?
- aka... "Environmental Fate"

16

NCC/STMA Fall Forum & General Membership Meeting 12/1/2010  
 Blankinship & Associates – Fate of Pesticides in the Environment



### “SEED”

Term	Also Known As:	Measured By:
<b>Stick</b>	Adsorb	Adsorption Coefficient
<b>Eat</b>	Metabolize	Half Life
<b>Evaporate</b>	Evaporate/ Volatilize	Vapor Pressure
<b>Dissolve</b>	Solubilize	Solubility

20

NCC/STMA Fall Forum & General Membership Meeting 12/1/2010  
 Blankinship & Associates – Fate of Pesticides in the Environment

Product/Active Ingredient	Solubility (mg/L)	Vapor Pressure (x 10 <sup>-8</sup> mm Hg)
<b>Garlon 4</b> (Triclopyr BEE)	7	360
<b>Garlon 3A</b> (Triclopyr TEA)	400,000	1

## Tasty.....Lets Eat!

100 to start

50

15

35

## Tasty.....Lets Eat !

100 molecules Today

50 molecules Tomorrow

Half Life (t<sub>1/2</sub>) = 1 Day

## The Risk Myth: Managing Exposure

- You Can't Change Toxicity...
- ...So Manage Exposure
  - Understand Environmental Fate
  - Use BMPs
  - Read the Label
  - Make An Informed Pesticide Selection

### The Risk Myth: Case Study

- Aquatic Use of Glyphosate for Control of Emergent Aquatic Vegetation



25

### Case Study: Glyphosate Risk

- Check carefully for those Registered for Aquatic Use
- Found in AquaMaster<sup>®</sup>, AquaPro<sup>®</sup> and Other Brand Name Herbicides



26

### Glyphosate Risk: Step #1 – Gather Toxicity Data

Organism	LC <sub>50</sub> (mg/L)	USEPA Classification
Fathead Minnow	97	Slightly Toxic
Juvenile Pink Salmon	14	Slightly Toxic
Juvenile Coho Salmon	27	Slightly Toxic
Rainbow Trout	140	Practically Non-Toxic
Water Flea	750	Practically Non-Toxic

USEPA Classification	Acute Aquatic LC <sub>50</sub> (mg/L)
Practically Non-Toxic	>100
Slightly Toxic	10-100
Moderately Toxic	1-10
Highly Toxic	0.1-1
Very Highly Toxic	< 0.1

### Glyphosate Risk: Step #2 – Estimate Exposure

- Using Label rates and lake volume treated, estimate expected concentration (i.e., exposure)
- Conservatively assume no degradation

29

### Glyphosate Risk: Step #3- Estimate Risk

- We now know the toxicity & exposure
- Estimate risk

30

### Glyphosate Risk: Step #3- Estimate Risk

- Use the “Hazard Quotient”
  - HQ =  $\frac{\text{Expected Concentration}}{\text{LC}_{50}}$
  - If HQ < 1, not likely a problem
  - If HQ > 1, maybe a problem

31

### Glyphosate Risk: Step #4- Communicate

Assume: 3 inches of water and 50 % Plant uptake

Pesticide	HQ
AquaMaster <sup>®</sup>	4/14 = 0.29
Cygnat Plus <sup>®</sup>	1.3/31 = 0.04

32

NCC/STMA Fall Forum & General Membership Meeting 12/1/2010  
Blankinship & Associates – Fate of Pesticides in the Environment

### Conclusions

- Treatment will be Efficacious
- Water Quality will be Protected
- Other BMPs Used:
  - Wind & Bird Nesting Prohibition

33

### Tools: Buffer BMPs



34

### More Tools: More BMPs

- Make multiple fertilizer applications in small amounts
- Select and use slow release fertilizer carefully
- Apply fertilizer based on soil & plant tissue testing & according to the label
- Do not apply fertilizer before rainfall/irrigation



35

### ...and More BMPs

- Periodically monitor surface and groundwater quality
- Establish and maintain healthy turf
- Maintain high heights of cut
- Recycle grass clippings
- Maintain Equipment
- Use IPM



36

NCC/STMA Fall Forum & General Membership Meeting 12/1/2010  
 Blankinship & Associates – Fate of Pesticides in the Environment

**2003-07 Golf Course Study**

- Does the choice of fertilizer (organic v. traditional) influence surface water quality adjacent to golf courses?
- Are pesticides leaving golf courses ?



37

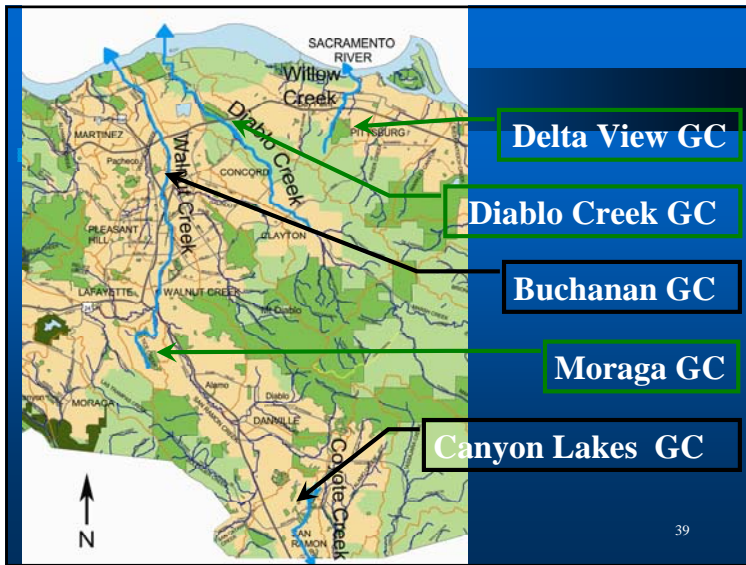
**Overview**

**Golf in Contra Costa Co.**

- 30 Courses
- 31 Watersheds
- Wide Geographic, Climatologic and Area-Specific Variability



38



39

**Methods**

- **Grab Samples**
  - Up and Down Stream of the Course
  - Sampled Primarily During Wet Weather Flow
- **Analysis**
  - Nutrients (NPK) & General Chemistry
  - Aquatic Toxicity (Algae & Water Flea)



40

NCC/STMA Fall Forum & General Membership Meeting 12/1/2010  
Blankinship & Associates – Fate of Pesticides in the Environment

## Results



- 3 storm seasons
- 17 rain storms
- 46 sample events
- > 1,000 water quality measurements made

41

## Summary of Results



- No insecticides leaving courses studied
- Fungicides/herbicides are not leaving traditional courses
- Nutrients maybe leaving traditional courses
- Algae-limiting agents maybe leaving organic courses

42

## Today's Talk



- Turf's Perception
- The Risk Myth
- Case Study
- Tools, Tools and More Tools
- Golf & Water Quality

43

## Questions?



Mike Blankinship  
(530) 757-0941  
[mike@h20sci.com](mailto:mike@h20sci.com)

44