

### One Step Forward, Two Steps Back: The Costs of Ignoring Ecology in Managing Pests



PRESENTED BY:  
Charles Benbrook, PhD  
The Organic Center  
cbenbrook@organic-center.org



Rachel Carson Memorial Lecture  
Brunei Gallery, London UK  
December 4, 2008

### Sweetcorn Production in Florida



### Sweetcorn Pest Management Outcomes

33,000 acres harvested in FLA

Army worms and silk flies

Average 13 insecticide applications – one every 4-5 days

In Georgia, 14 applications of methomyl (carbamate)



### Organic Sweetcorn in Florida

- Diversity
- Healthy soils
- Bt* + diamataceous earth
- Cleaner crop



### Consequences of Uncontrollable Blight in Organic Tomatoes



Systematic Biointensive IPM –  
Focus on prevention, not treatment

### Biointensive IPM is Information-Driven

Avoidance + Suppression (multiple life stages) +  
Treatments (multiple mechanisms, as needed)

### Fundamental Principles of BioIPM

- Real time, field-level information
- Grounded in commitment to manage ecological interactions for prevention
- Treatments only when populations exceed thresholds
- Suppress populations through "soft-approaches" at multiple life-stages – many little hammers
- Minimize reliance on any single control tactic or practice

### Systemic Pest Management – Control from within

### Systemic Options in Managing Pests

### Examples of Systemic Pesticides

- OPs**  
Acephate, chlorpyrifos, coumaphos, demeton, diazinon, methamidophos, disyston, dimethoate, fenamiphos, phorate, pirimiphos
- Carbamates**  
Aldicarb, carbaryl, carbofuran, methomyl, oxamyl
- Nicotinyls**  
Imidacloprid, thiamethoxam, thiacloprid, clothianidin, acetamiprid
- Others**  
Thiophanate-methyl, metalaxyl, foset-al, azoxystrobin, Bt-transgenics

### Factors Pushing Industry Toward More Reliance on Systemics

- Reduce worker exposures and risks
- Prevent exposures to birds and Beneficial insects (most of them)
- More application options
- Options to create new, exploit old intellectual property
- Pest management "solutions" in a bag

### Estimating the Contribution of Systemic Pesticides to Dietary Risk in the U.S.



USDA's "Pesticide Data Program" (PDP) provides world-class dataset

- 12-16 foods per year
- Residues as eaten
- Very sensitive methods
- Breaks out domestic and imported samples, organic, IPM-grown

Toxic potential based on EPA's chronic Reference Dose or cPAD (chronic Population Adjusted Dose)

### Dietary Risk Index (DRI)

Measures the relative toxic impact of a serving of food containing residues of a given pesticide

$$DRI = \frac{PDP \text{ mean or } 95^{th} \text{ residue}}{\text{chronic Reference Concentration (cRfC)}}$$

cRfC is the concentration (mg/kg) of a pesticide that can be in a serving of food without exceeding an individual's cRfD or cPAD

Focus on children 2-5 years old (about 40 pounds)

When DRI >1, dietary risk from a single food exceeds EPA "level of concern"

### Systemic Pesticides Account for a Major Share of Total Dietary Risk in the U.S.

U.S. Grown Foods													
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Systemics as % of Total DRI	36%	35%	32%	37%	28%	63%	62%	58%	62%	64%	56%	49%	51%

All Imports to the U.S.													
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Systemics as % of Total DRI	81%	65%	61%	28%	61%	38%	58%	27%	78%	73%	77%	68%	59%

### Fruits with the Highest DRI Scores and Share of Total DRI, 2000 - 2006

FRUITS							
	2000	2001	2002	2003	2004	2005	2006
Apples		19%	26%		8%	4%	
Cantaloupe	7%			3%	11%	6%	
Grapes	12%	8%			5%	8%	
Strawberries	13%				5%	11%	
Pears				10%	6%	5%	

### Vegetables with the Highest DRI Scores and Share of Total DRI, 2000 - 2006

VEGETABLES							
	2000	2001	2002	2003	2004	2005	2006
Cucumbers	14%		11%	25%	30%		
Green Beans	7%	13%			8%	14%	
Potatoes	9%	8%	14%				
Summer Squash							21%
Bell Peppers	9%		19%	14%	6%		
Tomatoes				19%	6%		
Winter Squash					6%	12%	7%

### Pesticides Accounting for Five Percent or More of Total Dietary Risk Index Values in Any Single Year, 2000 - 2006

U.S. Grown Foods							
	2000	2001	2002	2003	2004	2005	2006
Chlorpyrifos	31%	30%	32%	32%	21%	19%	32%
Heptachlor epoxide	3%	3%	7%		17%	6%	15%
Chlorpyrifos-methyl	<0.1%	0.1%	0.4%			9%	10%
Endosulfan sulfate	2%	3%	3%	2%	2%	2%	8%
Dieldrin	4%	3%	5%	4%	6%	4%	5%
Dicofol	11%	12%	6%	9%	7%	16%	2%
Methamidophos	19%	8%	13%	10%	21%	13%	5%
Diazinon	2%	5%	5%	8%	0.4%	2%	2%
Parathion	2%	4%	0.1%	6%			
Dimethoate	1%	6%	3%	4%	2%	4%	1%

### Importance of Tracking Systemic Pesticide Use to Manage Human Risk

- Systemic pesticides dominate dietary risk
- Likely will continue rising in use
- Cannot be easily eliminated by consumer (e.g. by washing)
- Complex analytical chemistry challenges (surprises ahead)
- Potential for physiological impacts on the plant, leading to new allergens, toxins, and risk assessment challenges
- ...and then there is the environment



### Managing Corn Insects – A Cautionary Tale

### The Demise of Corn IPM

- Extended diapause variant of western corn rootworm (CRW) undermined confidence in the corn-soybean rotation circa 1994
- Resistance to synthetic pyrethroid insecticides
- Emergence of *Bt* corn for European corn borer (ECB) circa 1997



### Turning to Systemics in Managing Corn Insects

- 1997 – *Bt* corn for ECB
- 2003 – *Bt* corn for corn rootworms
- 2004 – Nicotinyl seed treatments
- 2008 – First 8-stack corn variety and \$300 bag of seed corn (80,000 seeds)



### Systemics Now Dominant Corn Insect Pest Management

- Bt* corn (for ECB) on ~ 2/3<sup>rd</sup>s of corn acres (about 10% traditionally treated)
- Bt* corn (for corn rootworm) on 1/3<sup>rd</sup> corn acres
- Nicotinyl seed treatment ~ 100% of acres
- Systemic insecticide still sprayed on ~ 15% acres



### Big Steps Backward



- 10-fold increase in reliance on systemic toxins since mid-1990s
- 6-fold increase in seed cost since the 1970s
- Loss of choice – most new varieties at least 3-stacks and no non-GM options for most farmers

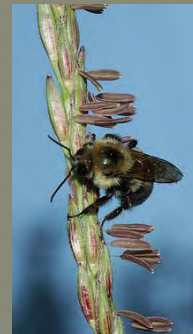


The Honeybee – The Food System's Canary in the Mineshaft?

While bee populations have crashed before, Colony Collapse Disorder (CCD) appears fundamentally different

### Possible Causes of CCD

- Varroa mite + viruses
- New viruses
- GM crops
- Cellphone towers
- Pesticides
- Nicotinyl sprays
- Nicotinyl seed treatments



### The Missing Piece of the Puzzle?



If Systemics are the Answer, What is the Question?



### Answers Worth a Fresh Look

Diversity is the key to population suppression

Healthy soils support strong plant and plant defenses

Multiple tactics aimed at several life-stages, leveraged by systematic pursuit of soft-spots

Pest management driven by ecological principles rather than corporate profits



### Actions Worth a Thousand Words

Worldwide moratorium on nicotiny seed treatments

Major restrictions on *any* pesticide uses routinely killing fish, birds and/or bees

Reclaim germplasm and reinvigorate public breeding programs

Investments in organic systems over next 20 years comparable to GE foods since the mid-1980s

