

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



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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

Crop 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%

Systemic 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; reliance on systemics likely to rise


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

Resistance spreading and could trigger profound changes in pesticide use patterns and risks

...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 ~ 2/3rds of corn acres (only about 10% traditionally treated with insecticides)


Bt corn (for corn rootworm) on 1/3rd corn acres

Nicotinyl seed treatment almost 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 corn varieties at least 2-stacks and few non-GM options for farmers



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

Possible Causes of CCD

- Varroa mite + viruses
- New viruses
- GM crops
- Cellphone towers
- Pesticides
- Nicotinyl sprays and/or seed treatments and/or carry-over in the soil and uptake by weeds



If Systemics are the Answer, What is the Question?



Answers Worth a Fresh Look

- Diversity is the key to pest population suppression
- Healthy soils support strong plants and plant defenses
- Multiple tactics aimed at several life-stages; target "soft-spots" in each organism's life cycle
- Ecological principles rather than corporate profits should drive pest management



Actions Worth a Thousand Words

- Worldwide moratorium on nicotinyl 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 the next 20 years comparable to GE technology investments since the mid-1980s – *Now that would be change worthy of the name!!*



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Thank you. For more information and a copy of these slides, see the "Pesticides" section of the Organic Center website –
<http://www.organic-center.org/science.pest.php>



For monthly updates on key new science on pest management and pesticide use, risks, and regulation, visit our home page and sign up for the free Organic Center electronic newsletter "The Scoop."