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Can you reduce pesticide risks and pest problems at the same time?

Working Out the Bugs

A continuing effort in Wisconsin models a promising pathway toward addressing both public and producer concerns over pesticide risk and pest control.

By Sarah Lynch, Deana Sexson, Chuck Benbrook, Mike Carter, Jeff Wyman, Pete Nowak, Jeb Barzen, Steve Diercks, John Wallendal

Farmers are under increasing pressure to develop and utilize less toxic methods of pest control. Federal regulations, including the Food Quality Protection Act (FQPA) and the Clean Water Act (CWA), constrain producers' pest management choices and could eliminate some widely used pesticides. Farmers and others in the food supply chain are responding to consumer concerns about pesticides by creating new market opportunities for products grown with more environmentally sensitive production systems.

Those interested in a viable agricultural sector are challenged to develop a proactive approach that enhances growers' abilities to take advantage of marketplace opportunities while complying with regulatory change.

A Precedent Setting Collaboration

Since the early 1980's, the University of Wisconsin and the Wisconsin Potato and Vegetable Growers Association (WPVGA) have been working to reduce pesticide inputs by incorporating Integrated Pest Management (IPM) into production systems. This effort has established performance indicators, targets, and timetables designed to accelerate adoption of economically viable biointensive IPM practices while reducing the use and reliance on high-risk pesticides. In 1996, the WPVGA, an agricultural com-



Loading seed potatoes into a hopper in Idaho: Does the Wisconsin effort hold promise for larger-scale operations?

modity association, and World Wildlife Fund (WWF), an environmental organization, entered into a precedent-setting partnership. The collaboration partners shared a vision that by increasing industry-wide adoption of biologically based integrated pest management (bioIPM) systems growers could reduce or eliminate their use of some highly toxic pesticides. In 1999 the potato Integrated Pest Management team at the University of Wisconsin-Madison officially joined the collaboration's executive committee generating the tongue-defy-

ing acronym: WWF/WPVGA/UW Collaboration. Hereafter, we refer to this as the "collaboration."

Collaboration partners agreed to work together to address five critical elements that would accelerate industry-wide transitions to pest and crop management systems aimed at reducing reliance on high-risk pesticides. The elements are:

1. Setting ambitious goals and timetables for measurable bioIPM adoption and pesticide use,
2. Promoting research and educational

Table 1 Pesticides Targeted for Reduction

Risk Criterion	11 Targeted Pesticides (active ingredient/trade name)	Type of pesticide
Acute Risk	Methamidophos (Monitor®)	Insecticide, organophosphate
	Azinphos-methyl (Guthion®)	Insecticide, organophosphate
	Carbofuran (Furadan®)	Insecticide, carbamate
	Oxamyl (Vydate®)	Insecticide, carbamate
Chronic Risk	Chlorothalonil (Bravo®)	Fungicide, B2 carcinogen
	Endosulfan (Thiodan®)	Insecticide, potential ED
	Mancozeb (Dithane®)	Fungicide, potential ED, B2 carcinogen
	Maneb	Fungicide, potential ED, B2 carcinogen
	Metribuzin (Sencor®)	Herbicide, potential ED
	Permethrin (Pounce®)	Insecticide, potential ED
	Triphenyltin hydroxide (SuperTin®)	Fungicide, potential ED, B2 carcinogen

- programs that emphasize alternative practices,
3. Developing and testing indicators for measuring progress in risk reduction and IPM adoption,
 4. Identifying opportunities to reward progress for meeting pesticide risk reduction goals, and
 5. Enhancing biodiversity.

An Advisory Committee, established in 1996, guides the collaboration toward its goals. Members of the committee include potato farmers, University researchers, food processors and retail industry representatives, farm service sector experts, and representatives of environmental, consumer and sustainable agriculture groups.

Setting Targets and Timetables

The collaboration initially decided to track eleven high-risk pesticides. Of these targeted pesticides, four were chosen because of their acute mammalian toxicity, and seven because of their chronic toxicity (suspected carcinogen and endocrine disruptor; see Table 1). One-, three- and five-year goals for reducing the use and reliance on these 11 target pesticides were set with progress to be measured in the 1997, 1999, and 2001 crop seasons. The goal was a progressive reduction in "toxicity units" of the eleven-targeted pesticides — 20 percent reduction by 1997, 40 percent reduction by 1999, and a 100 percent reduction by 2001. In addition, five- and ten- year goals were identified to achieve greater industry-wide adoption of biologically-based pest and crop management systems.

Data from USDA's National Agricultural Statistics Service were used to establish 1995 as the baseline year for pesticide use. In that year, the Wisconsin potato industry used an average of 15.4 pounds per acre of active ingredients in all herbicide, fungicide and insecticide applications (see Table 2, page 30). Out of that total, 13.5 pounds of active ingredients per acre, roughly 88 percent of all pesticides used in that year, came from the 11 targeted pesticides.

Measuring Pesticide Risk Reduction

The collaboration struggled with a way to measure progress in reducing high-risk pesticide use. The common "pounds of product or active ingredient" was rejected, because misleading results can follow from assessing only changes in pounds applied. For example, one ounce of a high-risk pesticide can pose a far greater real risk than one pound of a low-risk product — a possibility not captured by volume measures. While the focus was on reducing use of 11 high-risk pesticides, we also wanted to monitor the possible substitution of other high-risk materials.

Collaboration partners recognized that there is no one "right way" to measure pesticide risk, and alternative approaches each have advantages and disadvantages. The collaboration finally agreed to use a multiattribute index and data on pounds applied to calculate pesticide-specific toxicity units, our preferred measure of relative pesticide risk. The index approach allowed us to include four components that reflect our joint concerns: 1) acute mammalian toxicity; 2) chronic mammalian toxicity; 3) ecotoxicity (risks to small aquatic organisms, fish, and birds); and 4) impacts on the viability of biointensive IPM (such as effects on beneficial organisms, bees, and resistance management). Toxicity factors allow the active ingredients of individual pesticides to be compared on a pound-for-pound basis so that the relative potential of a pesticide to pose human, wildlife and bioIPM risks can be compared.

We used the index to calculate a toxicity factor for each active ingredient registered for use on Wisconsin potatoes. The range of toxicity factor values for these pesticides is quite wide, starting with a low of 47 and rising to a high of 482. In order to measure industry-wide changes in pesticide risk, toxicity units for each pesticide

Partners recognized that there is no one "right way" to measure pesticide risk.

Table 2. Achievement of WWF-WPVGA-UW One and Three-Year Pesticide Risk Reduction Goals — Reductions in Combined Toxicity Units Across 11 Targeted Pesticides in 1995, 1997, and 1999

Wisconsin Acres 1995 = 83,000 Wisconsin Acres 1997 = 78,000 Wisconsin Acres 1999 = 86,000	Toxicity Factor Values	Pounds Applied 1995	1995 Toxicity Units	Pounds Applied 1997	1997 Toxicity Units	Pounds Applied 1999	1999 Toxicity Units
Acute Risk Pesticides							
Methamidophos	339	69,000	23,363,400	17,000	5,756,200	15,000	5,079,000
Azinphos-methyl	307	26,000	7,987,200	-	-	6,000	1,843,200
Carbofuran	403	13,000	5,242,900	-	-		0
Oxamyl	440	5,000	2,199,500	-	-	5,000	2,199,500
Total: 4 Acute Pesticides		113,000	38,793,000	17,000	5,756,200	26,000	9,121,700
Per Planted Acre		1.4	467	0.2	73.8	0.3	106
Chronic Risk Pesticides							
Mancozeb	198	412,000	81,370,000	287,000	56,682,500	278,000	54,905,000
Chlorothalonil	82	408,000	33,374,400	591,000	48,343,800	501,000	40,981,800
Endosulfan	271	60,000	16,260,000	10,000	2,710,000	53,000	14,363,000
Maneb	162	76,000	12,334,800	62,000	10,062,600	-	0
Triphenyltin hydroxide	385	12,000	4,616,400	8,000	3,077,600	2,000	769,400
Metribuzin	127	39,000	4,968,600	34,000	4,331,600	37,000	4,713,800
Permethrin	288	4,000	1,151,200	-	-	1,000	287,800
Total: 7 Chronic Pesticides		1,011,000	154,075,400	992,000	125,208,100	872,000	116,020,800
Per Planted Acre		12.2	1,856	12.7	1,605	10.1	1,349
11 Targeted Pesticides: Totals							
Per Planted Acre		13.5	2,324	12.9	1,679	10.4	1,455
Percent Change per Acre 1995-1997							
Percent Change per Acre 1995-1999							
All Herbicides, Fungicides, & Insecticides							
Total Toxicity		1,277,166	207,774,778			1,163,068	169,317,540
Per Planted Acre		15.4	2,503			13.5	1,969
Percent Change per Acre 1995-1999							-21%

were calculated by multiplying toxicity factor values by total pounds of active ingredients applied of each specific pesticide. For example, the insecticide methamidophos has a toxicity factor of 339. Multiplying this by the approximately 69,000 pounds of active ingredients of methamidophos applied in 1995 yields approximately 23.4 million toxicity units for that year.

Achievements in Risk Reduction

Progress in reducing industry-wide toxicity units is measured by summing the toxicity units of the 11 targeted pesticides and subtracting the sum from the 1995 toxicity unit baseline. The toxicity units are converted to a per acre basis to eliminate the impact of year-to-year changes in the acres of potatoes planted.

In the baseline year, the 11 targeted pesticides accounted for a total of 192.9 million toxicity units, or 2,324 per planted acre. Fungicides accounted for about 68 percent of the total (Table 2). By 1997, the first target year, Wisconsin potato growers had reduced the toxicity units per planted acre associated with the 11 targeted pesticides by 28 percent, exceeding the collaboration's 20 percent first year goal.

In 1999, the third target year, the toxicity units for the 11 targeted pesticides had decreased to about 125 million or 1,455 toxicity units per acre — a 37 percent reduction in per acre toxicity units when measured against the 1995 baseline, but shy of the collaboration's 40 percent goal. While not achieving the third year target, this result is impressive given that it occurred in a period of depressed prices, and under continued pressure from a late blight.

What Changes Did Wisconsin Growers Make?

The potato growers of Wisconsin have a long history of willingness to adopt new technological advances. In the past three years, Wisconsin growers have been able to make significant progress in reducing their reliance on high toxicity pesticides by incorporating some of these technological advances into their production systems. Specifically, the introduction of two new reduced-risk pesticides, the insecticide imidacloprid (Admire®) and the fungicide azoxystrobin (Quadris®) has contributed

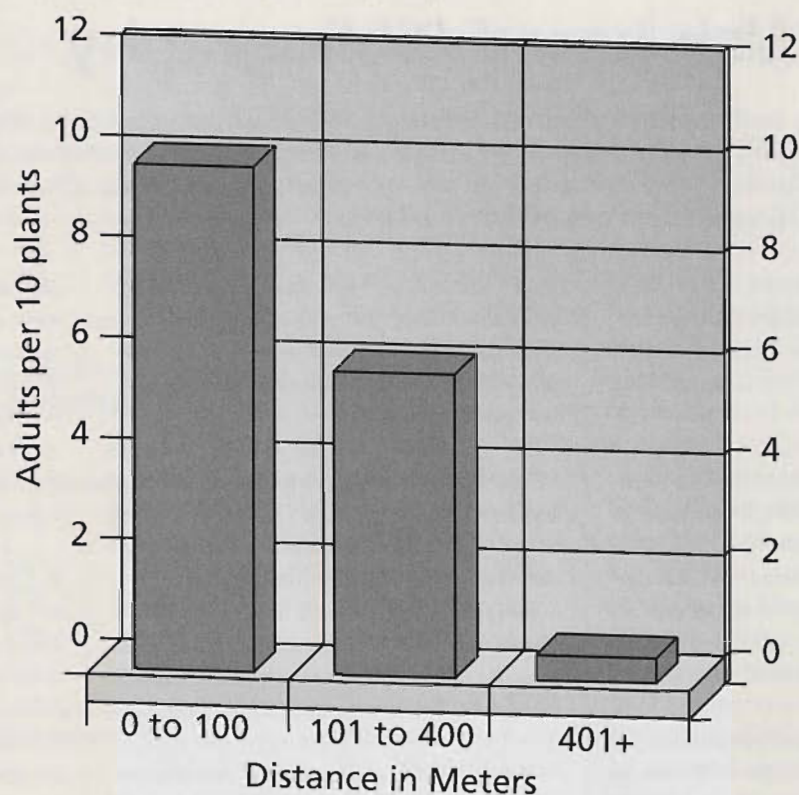
greatly to toxicity reduction. Compared to the older pesticides in common use, these new products have lower toxicity factors and are applied at lower rates. Growers have adopted these products despite the fact that they are more costly than other materials.

Growers have made impressive use of the new reduced-risk materials, but there has also been some substitution of other high-risk pesticides for the targeted materials. Some of this substitution may be inevitable during a transition to a biologically based pest management system if it helps ensure that pests do not develop a resistance to the newer, safer materials. Measurement methods that can track substitution trends are used to ensure that the overall goals of reduced risk and reliance on highly toxic pesticides are being achieved. Toxicity units calculated for all pesticides used in Wisconsin potato production reveal that by 1999, toxicity units per acre had declined by 21 percent — a significant decline, but less than the 37 percent reduction in the 11 targeted pesticides.

Prospects for Increasing Adoption of BioIPM Systems

Opportunities for achieving greater reductions in pesticide toxicity in Wisconsin potato production are quite promising. The implementation of other Biointensive IPM approaches, such as biological control, cultural controls, and soil health and quality measures, will further aid

Figure 1: Colorado potato beetles per 10 plants by distance from previous year's potato fields, Portage County, Wis., 1997.



Too Far To Fly:
Beetle populations fall when crops are rotated, as much as 90% if new fields are at least 400 meters from the old ones.

FQPA Commentary coming next issue:

Dr. Scott Swinton and Dr. Sandra Batie in the Department of Agricultural Economics at Michigan State University will author a synthesis/commentary on the four FQPA articles offered this third-quarter issue.

in the reduction of pesticide toxicity.

For example, recent research has confirmed that populations of the Colorado potato beetle can be dramatically reduced when the distance between potato fields from year to year is maximized. If the rotational distance is at least 400 meters from the old field, beetle populations can be reduced by 90 percent compared to a field planted adjacent to the previous year's field (Sexson, 2000).

Most potatoes in Wisconsin are grown in a three-year rotation with other vegetable and grain crops, which makes this approach feasible. Furthermore, there is no additional cost to the grower to implement a rotational scheme such as this, and this approach can be extremely effective if growers plan their rotations with their neighbors.

The collaboration now has a full time outreach coordinator working with interested growers to incorporate area wide and other bioIPM approaches into their farming systems. The outreach coordinator uses individual farm data to develop field or farm plans that better incorporate bioIPM practices.

A Model for Risk Reduction

The collaboration's achievements have taken place against a national backdrop of general disagreement over pesticide use and implementation of the FQPA. This effort models a promising alternative — an effective multi-stakeholder approach for proactively addressing the public's concern over pesticide use and the protection of the environment using voluntary, incentive-based

strategies. The collaboration framework provides a forum where an array of stakeholders can discuss and identify approaches to pest and crop management that will help keep agricultural production economically viable while at the same time reducing unintended impacts in fragile ecosystems. ■

■ For More Information

Benbrook, Charles, E. Groth, M. Hanson, J. Halloran, and S. Marquardt. *Pest Management at the Crossroads*. Yonkers, NY: Consumers Union. 1996.

Hoppin, P. "Reducing Pesticide Reliance and Risk Through Adoption of IPM: An Environmental and Agricultural Win-Win." *Proceedings of the Third National IPM Symposium/Workshop*, Lynch, S., C. Greene, and C. Kramer-LeBlanc, eds., Economic Research Service Report, Miscellaneous Publication Number 1542 – May 1997.

Sexson, D.L. "Colorado Potato Beetle Movement and Survival in Wisconsin Potatoes: the Development of an Area-Wide Management Strategy." Ph.D. dissertation, University of Wisconsin- Madison, 2000.

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A Short Web-based Bibliography

Hundreds of authors and commentators have written about various aspects of the Food Quality Protection Act. The law has been subject to alternative interpretations and to much controversy. One short bibliography cannot provide access to informed judgements on all sides of the issue. CHOICES offers the following because of their accessibility and the range of opinions that they address.

1. Public Law 104-170. Accessible through links from <<http://thomas.loc.gov/bss/d104/d104laws.html>>. This site provides links to the Public Law as well as the supporting material from Congress. Very detailed.

2. Linda-Jo Schierow, "Pesticide Residue Regulation: Analysis of Food Quality Protection Act Implementation," CRS Issue Brief RS 20043, August 3, 1999. Available at <<http://www.cnire.org/nle/pest-10.html>> A comprehensive discussion of the law and the problems associated with its appropriate application. Links to other sites.

3. Scott Rawlins, "Food Quality Protection Act — Challenges Ahead." Washington, DC. American Farm Bureau Federation, August, 1997.

Available at <<http://www.fb.com/issues/analysis/foodqual.html>> An early private-sector view of the testing methods used by EPA and the possible effects on individual consumers and on food producers.

4. Environmental Protection Agency, Office of Pesticide Programs. "Food Quality Protection Act (FQPA) Background." Available at <<http://www.epa.gov/opppsp1/fqpa/backgrnd.htm>> A comprehensive site with links to numerous governmental and scientific sources. The site can be used for a summary view; the links will provide details. This site was updated in April, 2000.

5. American Crop Protection Association. "FQPA" Available at <<http://www.acpa.org/>

[public/issues/fqpa/indexfqpa.html](http://www.acpa.org/public/issues/fqpa/indexfqpa.html)> ACPA provides a list of links to provide access to many sources of information on FQPA. The link, "Here Today, Gone Tomorrow. Act Now for FQPA!" provides a published schedule of EPA testing activity as well as an easy-to-follow demonstration of how the different categories of pesticide risk are calculated. The site was updated in November, 1999.

6. Council for Agricultural Science and Technology. "The FQPA: A Challenge for Science Policy and Pesticide Regulation." A detailed executive summary of a conference held in March 1999. Topics relate to all aspects of the FQPA. One session concentrates on effects of the law on agriculture. Available at <<http://www.cast-science.org/fqpa/fqpa.htm>> ■