

# *Accelerating Industry-Wide Transition to Reduced-Risk Pest Management Systems: A Case Study of the Wisconsin Potato Industry*

By:

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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

“Biointensive IPM is a systems approach to pest management based on an understanding of pest ecology. It begins with steps to accurately diagnose the nature and source of pest problems, and then relies on a range of preventive tactics and biological controls to keep pest populations within acceptable limits. Reduced risk pesticides are used if other tactics have not been adequately effective, as a last resort and with care to minimize risks.” (Benbrook, 1996, p. 4)

responding to consumer concerns about pesticides by creating new market opportunities for products grown using more environmentally sensitive production systems.

Those interested in a viable agricultural sector, are challenged to develop a proactive approach that enhances growers' ability to take advantage

of marketplace opportunities while still complying with regulatory change. Here, we report on the progress of a project that established performance indicator, targets, and timetables designed to accelerate adoption of economically viable biointensive IPM practices while reducing the use and reliance on high-risk pesticides. We describe the results of the first three years of this initiative, focusing specifically on pesticide risk reduction results.

## **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 incorporate Integrated Pest Management (IPM) into the production system to reduce pesticide inputs. In 1996, the WPVGA, an agricultural commodity 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-defying 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 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 or endocrine disruptor) (Table 1). One-, three- and five-year goals for reducing the use and reliance of 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” (discussed below) 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.

| Table 1 Pesticides Targeted for Reduction |  |   |
|---|--|---|
| Risk Criterion                            | 11 Targeted Pesticides<br>(active ingredient/trade name)   | Type of pesticide   |
| Acute Risk                                | Methamidiphos (Monitor®)<br>Azinphos-methyl (Guthion®)<br>Carbofuran (Furadan®)<br>Oxamyl (Vydate®)  | Insecticide, organophosphate<br>Insecticide, organophosphate<br>Insecticide, carbamate<br>Insecticide, carbamate  |
| Chronic Risk                              | Chlorothalonil (Bravo®)<br>Endosulfan (Thiodan®)<br>Mancozeb (Dithane®)<br>Maneb<br>Metribuzin (Sencor®)<br>Permethrin (Pounce®)<br>Triphenyltin hydroxide (SuperTin®) | Fungicide, B <sub>2</sub> carcinogen<br>Insecticide, potential ED<br>Fungicide, potential ED, B <sub>2</sub> carcinogen<br>Fungicide, potential ED, B <sub>2</sub> carcinogen<br>Herbicide, potential ED<br>Insecticide, potential ED<br>Fungicide, potential ED, B <sub>2</sub> carcinogen |

Data from USDA’s National Agricultural Statistics Service were used to establish 1995 as the pesticide use baseline. 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 (Table 2). 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. (One ounce of a high-risk pesticide can pose a far greater real risk than one pound of a low-risk product, something not captured by volume measures.) Furthermore, while the focus was on reducing use of 11 high-risk pesticides, we 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 (effects on beneficial organisms, bees, and resistance management) (Benbrook, et al.). Toxicity factors allow the active ingredients of individual pesticide 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 major potato pesticides used in Wisconsin 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 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 adapt 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®) have greatly contributed to the toxicity reduction. Compared to the older pesticides in common use, these new products have lower toxicity factors and are applied at lower rates and the growers have rapidly utilized these products despite the fact that these products 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 biologically based pest management system if it helps to 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

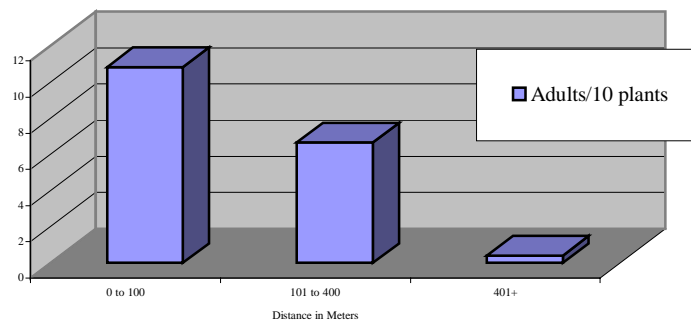
production reveal that by 1999, toxicity units per acre had declined by 21 percent – a significant decline, but less than the 37 percent reduction in the 11 targeted pesticides.

### **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 in the reduction of pesticide toxicity.

For example, recent research has confirmed that populations of 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).

**Colorado potato beetles per 10 plants vs. distance from previous years potato fields, Portage County, WI 1997.**



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 work uses individual farm data to develop field or farm plans that better incorporate bioIPM practices.

### **A Model for Risk Reduction in Agriculture**

The collaboration's achievements have taken place against a national backdrop of general disagreement over pesticide use and implementation of the FQPA. The collaboration offers 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 keep agricultural production economically viable while at the same time reducing unintended impacts in fragile ecosystems.

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### **For more information**

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

| Wisconsin Acres 1995 = 83,000<br>Wisconsin Acres 1997 = 78,000<br>Wisconsin Acres 1999 = 86,000 | Toxicity<br>Factor<br>Values | Pounds<br>Applied 1995 | 1995 Toxicity<br>Units | Pounds Applied<br>1997 | 1997 Toxicity<br>Units | Pounds Applied<br>1999 | 1999 Toxicity Units |
|---|------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------------|
| <b><u>Acute Goal</u></b>  |                              |                        |                        |                        |                        |                        |                     |
| 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           |
| <b>Total: 4 Acute Pesticides</b>  |                              | <b>113,000</b>         | <b>38,793,000</b>      | <b>17,000</b>          | <b>5,756,200</b>       | <b>26,000</b>          | <b>9,121,700</b>    |
| <b>Per Planted Acre</b>   |                              | <b>1.4</b>             | <b>467</b>             | <b>0.2</b>             | <b>73.8</b>            | <b>0.3</b>             | <b>106</b>          |
| <b><u>Chronic Goal</u></b>  |                              |                        |                        |                        |                        |                        |                     |
| 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             |
| <b>Total: 7 Chronic Pesticides</b>  |                              | <b>1,011,000</b>       | <b>154,075,400</b>     | <b>992,000</b>         | <b>125,208,100</b>     | <b>872,000</b>         | <b>116,020,800</b>  |
| <b>Per Planted Acre</b>   |                              | <b>12.2</b>            | <b>1,856</b>           | <b>12.7</b>            | <b>1,605</b>           | <b>10.1</b>            | <b>1,349</b>        |
| <b>11 Targeted Pesticides: Totals</b>   |                              | <b>1,124,000</b>       | <b>192,868,400</b>     | <b>1,009,000</b>       | <b>130,964,300</b>     | <b>898,000</b>         | <b>125,142,500</b>  |
| <b>Per Planted Acre</b>   |                              | <b>13.5</b>            | <b>2,324</b>           | <b>12.9</b>            | <b>1,679</b>           | <b>10.4</b>            | <b>1,455</b>        |
| <b>Percent Change per Acre 1995-1997</b>  |                              |                        |                        |                        | <b>-28%</b>            |                        |                     |
| <b>Percent Change per Acre 1995-1999</b>  |                              |                        |                        |                        |                        |                        | <b>-37%</b>         |
| <b>All Herbicides, Fungicides, &amp; Insecticides</b>   |                              |                        |                        |                        |                        |                        |                     |
| <b>Total Toxicity</b>   |                              | <b>1,277,166</b>       | <b>207,774,778</b>     |                        |                        | <b>1,163,068</b>       | <b>169,317,540</b>  |
| <b>Per Planted Acre</b>   |                              | <b>15.4</b>            | <b>2,503</b>           |                        |                        | <b>13.5</b>            | <b>1,969</b>        |
| <b>Percent Change per Acre 1995-1999</b>  |                              |                        |                        |                        |                        |                        | <b>-21</b>          |