Attainment of 1997 Industry-wide Pesticide Risk Reduction Goals: Technical Report to WWF and WPVGA

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The establishment of concrete targets for reducing pesticide reliance and risks is a critical component of the cooperative project sponsored by the World Wildlife Fund (WWF) and the Wisconsin Potato and Vegetable Growers Association (WPVGA). Reducing the use of broad-spectrum, high-risk pesticides has been a WPVGA goal for several years, driven by the Association's commitment to –

- Improve the purity of the region's shallow ground water;
- Protect the health of rural community residents, farmers and their families; and
- Enhance the quality of wildlife habitat and the diversity of species sharing the agricultural landscape.

Since 1996 WWF and WPVGA have carried out a range of activities to help accelerate progress in reducing reliance on pesticides through the adoption of biointensive Integrated Pest management (IPM) in the Central Sands region of the state. Incremental industry-wide pesticide risk reduction and IPM adoption goals have been set and apply across all Wisconsin potato acreage and growers, most of whom are members of WPVGA.

The first major test set forth in the project's Memorandum of Understanding was reducing reliance in 1997 on 11 high-risk pesticide active ingredients in contrast to their use in 1995. With the release May 20, 1998 of the U. S. Department of Agriculture's "1997 Agricultural Chemical Use Estimates for Field Crops," it is now possible to assess attainment of this initial risk reduction goal.

A. Risk Reduction Goals

The October 1996 WWF-WPVGA Memorandum of Understanding spells out preliminary pesticide use and risk reduction goals applicable to crop seasons 1997, 1999, and year 2001. Two criteria were agreed upon in identifying which of the 31 pesticide active ingredients applied in 1995 that would be subject to risk reduction goals.

Acute Risk

Pesticides classified as "Extremely Hazardous" or "Highly Hazardous" by the World Health Organization in terms of acute mammalian toxicity fall under the project's acute toxicity reduction target -- 25 percent reduction in 1997compared to 1995 use. (The U.S. Department of Agriculture did not survey Wisconsin potato farms in 1996. USDA did collect Wisconsin potato pesticide use data in 1995, the year chosen as the baseline year for monitoring attainment of reduction goals).

Four insecticides triggered the acute toxicity criterion: the organophosphates (OP) azinphos-methyl (Guthion) and methamidophos (Monitor), and the carbamates carbofuran (Furadan) and oxamyl (Vydate).

In 1995, there were 113,000 pounds of these four active ingredients applied across the 83,000 acres of potatoes planted in the state, as shown in Table 1. These four pesticides accounted for just under 60 percent of the total pounds of insecticides applied that year – heightening the importance and difficulty of achieving the 25 percent goal.

The preliminary three-year acute risk reduction goal set for crop season 1999 was a 50 percent reduction from the 1995 baseline. The five-year goal calls for the use of any pesticides falling in this highly dangerous and disruptive class to be phased out by the end of crop season 2001.

Chronic Risk

The second risk reduction criterion targets pesticides that pose longer-term risks to humans from low-level, chronic exposures. Any pesticide that is a known endocrine disruptor or a Class A or B_2 carcinogen is subject to a 15 percent chronic toxicity reduction goal between 1995 and 1997.

Seven active ingredients fall under this criterion: the herbicide metribuzin (Sencor), the insecticides permethrin (Pounce) and endosulfan (Thiodan), and the fungicides maneb, mancozeb (Dithane), chlorothalonil (Bravo), and triphenyltin hydroxide (Super Tin). Reducing use of the insecticide Thiodan was a high-priority goal for the collaboration because of the firm evidence compiled by the WWF Contaminants and Wildlife Program demonstrating the capacity of endosulfan to disrupt endocrine system functions.

In 1995 there were 1,100,000 pounds applied of these seven active ingredients in the Wisconsin potato industry. The four key fungicides within this group account for 92 percent of the total pounds of fungicides applied in 1995, highlighting the need for safer, reduced risk fungicide alternatives.

The chronic risk reduction goal was set at the more modest level of 15 percent for two reasons. First, the lack of evidence of human exposure to the seven active ingredients triggering the chronic risk criterion under the conditions of their use in Wisconsin potato production. Residues of these products are found rarely in fresh or processed potato products, nor do they appear in drinking water. Second, the continuing difficulty growers have faced in managing the outbreak of a new strain of the potentially devastating disease late blight, which hit the industry in 1994 and has grown increasingly virulent since.

Table 1. Wisconsin Potato Pesticide Use and Toxicity Units: 1995 and 1997							
	Toxicity Factor Values	**1995 Acres Treated**	**1995 Pounds Applied**	**1995 Toxicity Units**	**1997 Acres Treated**	**1997 Pounds Applied**	**1997 Toxicity Units**
Herbicides:							
Glyphosate	78.0	6,640	4,000	312,000	7,800	9,000	702,000
Linuron	73.1	7,470	7,000	511,700	5,460	3,000	219,300
Metolachlor	47.8	14,940	21,000	1,003,800	4,680	7,000	334,600
Metribuzin	126.6	73,870	39,000	4,937,400	72,540	34,000	4,304,400
Pendimethalin	166.6	29,880	24,000	3,998,400	22,620	16,000	2,665,600
Sethoxydim	60.8	8,300	2,000	121,600	0	0	0
Total: All Herbicides		**141,100**	**97,000**	**10,884,900**	**113,100**	**69,000**	**8,225,900**
Per Planted Acre		**1.7**	**1.2**	**131**	**1.5**	**0.9**	**105**
Insecticides:							
Azinphos-methyl	220.3	21,580	26,000	5,727,800	0	0	0
Carbofuran	383.5	13,280	13,000	4,985,500	0	0	0
Dimethoate	314.4	23,240	11,000	3,458,400	46,020	30,000	9,432,000
Endosulfan	288.5	54,780	60,000	17,310,000	10,140	10,000	2,885,000
Esfenvalerate	417.0	49,800	3,000	1,251,000	46,020	2,000	834,000
Imidachloprid	115.0	0	0	0	36,660	8,000	920,000
Methamidophos	199.7	53,950	69,000	13,779,300	17,160	17,000	3,394,900
Oxamyl	282.0	6,640	5,000	1,410,000	0	0	0
Permethrin	264.7	18,260	4,000	1,058,800	0	0	0
Piperonyl butoxide	48.7	14,110	3,000	146,100	17,940	7,000	340,900
Pyrethrins	164.3	8,300	830	136,369	0	0	0
Total: All Insecticides		**263,940**	**194,830**	**49,263,269**	**173,940**	**74,000**	**17,806,800**
Per Planted Acre		**3.2**	**2.3**	**594**	**2.2**	**0.95**	**228**
Fungicides:							
Basic copper sulfate	42.1	4,150	13,000	547,300	7,020	8,000	336,800
Chlorothalonil	79.8	73,040	408,000	32,558,400	75,660	591,000	47,161,800
Copper hydroxide	51.5	31,540	40,000	2,060,000	31,980	52,000	2,678,000
Copper resinate	50.5	5,810	12,000	606,000	10,140	2,000	101,000
Cymoxanil	62.0			17,940	17,940	5,000	310,000
Mancozeb	180.0	71,380	412,000	74,160,000	52,260	287,000	51,660,000
Maneb	153.9	11,620	76,000	11,696,400	16,380	62,000	9,541,800
Metalaxyl	172.0	12,450	4,000	688,000	0	0	0
Propamocarb hydroch.	51.1	9,960	9,000	459,900	0	0	0
Triphenyltin hydroxide	424.0	38,180	12,000	5,088,000	36,660	8,000	3,392,000
Total: All Fungicides		**258,130**	**986,000**	**127,881,940**	**248,040**	**1,015,000**	**115,181,400**
Per Planted Acre		**3.1**	**11.9**	**1,541**	**3.2**	**13.0**	**1,477**
Herbicides, Insecticides, and Fungicides							
Total: H+I+F		**663,170**	**1,277,830**	**188,030,109**	**535,080**	**1,158,000**	**141,214,100**
Per Planted Acre		**8.5**	**15.4**	**2,265**	**6.9**	**14.8**	**1,810**

B. Measuring Progress

Since the goal of the project is to limit human health risks and promote improvement in environmental quality, the project developed an index of pesticide toxicity levels encompassing the ecological, environmental and human health risks associated with application of different active ingredients (see Appendix 1). The index was used to calculate a "toxicity factor value" for each pesticide active ingredient. These values allow comparisons across active ingredients on a pound-for-pound basis, and are reported in the first column of Table 1.

For example, the WWF-WPVGA Toxicity Factor Value of the recently registered insecticide imidachloprid (Admire) is 115. The toxicity factor values for the insecticides that Admire has replaced in management of the Colorado potato beetle are much higher – for example, carbofuran at 383.5.

The pounds applied of each of the 11 active ingredients subject to risk reduction goals were converted to toxicity units. Toxicity units are calculated by multiplying the pounds applied of a pesticide by the pesticide's toxicity factor value. The result of this calculation for 1995 is shown in the fourth column in Table 1. The last column shows 1997 toxicity units -- pounds applied in 1997 multiplied by the same toxicity factor values.

Progress from 1995 to 1997 in reducing risk is then estimated by the reduction in overall toxicity units. Subsequent tables include several indicators of progress, each based on changes in some measure of industry-wide toxicity units. Some are expressed in terms of industry-wide totals, others on the basis of averages per planted acre.

Note that the pounds applied of a given type of pesticide, either industry-wide or per acre, can rise while toxicity units fall. This occurs when the increase in pounds applied is more than offset by lower toxicity factor values. Change in fungicide use in Wisconsin between 1995 and 1997 is an example – 10 percent more pounds were applied on the average acre but toxicity units still fell 4 percent, as shown in Table 2, because of a shift to products with markedly lower toxicity factor values.

Indicators of Progress

Key indicators of progress are presented in Table 2. The percentages shown in the table are reductions achieved from 1995 to 1997. For example, across the 11 active ingredients subject to reduction goals, the acres treated in 1997 fell 36 percent from the 1995 total.

Table 2. Progress in Reducing Pesticide Use and Risks in Wisconsin Potato Production: Percent Reduction in 1997 from 1995 Baseline Values

	Acres Treated	Pounds Applied	Pounds Per Acre Planted	Industry-wide Toxicity Units	Toxicity Units Per Planted Acre
~~11 Active Ingredients Subject to Reduction Goals~~	**36%**	**10%**	**4%**	**29%**	**25%**
~~All Pesticides~~					
Herbicides	20%	29%	24%	24%	20%
Insecticides	34%	61%	59%	64%	61%
Fungicides	4%	-3%	-10%	10%	4%
~~All Herbicides, Insecticides, and Fungicides~~	**19%**	**9%**	**3%**	**25%**	**20%**

Table 2 shows clearly the remarkable progress made in just two years by the collaboration and the Wisconsin potato industry. The last two columns contain the most important measures of progress – "Industry-wide Toxicity Units" and "Toxicity Units per Planted Acre." The first measure reflects changes in the overall number of toxicity units associated with pesticides applied in the Wisconsin potato industry. It is the best broad indicator of the overall potential impacts of pesticide use in the six-country region where most potatoes are grown in the state. "Toxicity Units per Planted Acre" for 1995 is simply industry-wide toxicity units divided by the total acres planted. In 1995, there were 83,000 acres of potatoes grown in Wisconsin, and in 1997, 78,000 acres. The five thousand-acre drop in total acres planted accounts for about a 6 percent decrease in industry-wide toxicity units.

From the perspective of the individual farmer, comparing pesticide use on a per-acre-planted basis is just as important as changes across the whole industry. The last column in Table 2 reports this key indicator of progress from 1995 to 1997. In just two years on the average acre planted, Wisconsin potato growers were able to –

- Reduce per acre toxicity units 25 percent across the 11 pesticides subject to the acute and chronic risk reduction goals, more than meeting the first-year reduction goal;
- Decrease insecticide toxicity units a remarkable 61 percent; and
- Achieve a 20 percent reduction in the toxicity units across all herbicides, insecticides, and fungicides applied.

Further details on the reductions achieved are presented in Table 3. The reason behind the stunning reduction in acute toxicity units is clear in this table – there was no reported use of three of the four insecticides triggering the reduction goal. We studied further the just-released National Agricultural Statistics Service (NASS) data since NASS sometimes reports pesticide use as zero when there was, in fact, some level of use. This occurs when NASS has just one or a few sample points in a survey reporting limited use of a given chemical. For statistical reasons, NASS is reluctant to base a state-wide extrapolation of pesticide use on such a small sample.

With help from Michael Peterson, a graduate student working with Dr. Pete Nowak, a University of Wisconsin professor and member of the project advisory committee, we assessed the raw pesticide use data on valid field sample points for 1997. We found no reported applications of oxamyl and carbofuran, consistent with the report of zero pounds applied. Just over 5 pounds of azinphos-methyl were used on one 10-acre field. Less than 15 pounds of permethrin were applied on five fields. Accordingly, it is clear that the use of these four active ingredients was indeed very modest in 1997. This conclusion and the NASS survey results are further supported by the results of a mid-season WPVGA survey of a sample of its members.

Table 3. Pesticide Risk Reduction Goals and Accomplishments: 1995 to 1997				
Wisconsin Acres 1995 = 83,000 Wisconsin Acres 1997 = 78,000	**Pounds Applied 1995**	**1995 Toxicity Units Subject to Reduction Goals**	**Pounds Applied 1997**	**1997 Toxicity Units**
~~**Acute Goal**~~				
Methamidophos	69,000	13,779,300	17,000	3,394,900
Azinphos-methyl	26,000	5,727,800	-	-
Carbofuran	13,000	4,985,500	-	-
Oxamyl	5,000	1,410,000	-	-
Total: 4 Acute Pesticides	**113,000**	**25,902,600**	**17,000**	**3,394,900**
Per Planted Acre	**1.36**	**312**	**0.22**	**43.5**
Reduction Needed to Meet 25% Industry-wide Goal		6,475,650		
Actual Reduction: 1995 to 1997		22,507,700		
Muliple of Needed Reduction		3.5		
~~**Chronic Goal**~~				
Mancozeb	412,000	74,160,000	287,000	51,660,000
Chlorothalonil	408,000	32,558,400	591,000	47,161,800
Endosulfan	60,000	17,310,000	10,000	2,885,000
Maneb	76,000	11,696,400	62,000	9,541,800
Triphenyltin hydroxide	12,000	5,088,000	8,000	3,392,000
Metribuzin	39,000	4,937,400	34,000	4,304,400
Permethrin	4,000	1,058,800	-	-
Total: 7 Chronic Pesticides	**1,011,000**	**146,809,000**	**992,000**	**118,945,000**
Per Planted Acre	**12.2**	**1,769**	**12.7**	**1,525**
Reduction Needed to Meet 15% Industry-wide Goal		22,021,350		
Actual Reduction: 1995 to 1997		27,864,000		
Muliple of Needed Reduction		1.3		

Table 3 shows that there were about 26 million toxicity units associated with the four pesticides triggering the acute risk reduction criterion, or 312 per planted acre. To meet the reduction goal in crop season 1997, the toxicity units associated with active ingredients meeting the acute risk trigger must not exceed 234 per acre. The actual reduction achieved – 268 – was 3.5 times greater than necessary to meet the goal.

There were about 147 million toxicity units in 1995 associated with the use of the seven active ingredients triggering the chronic toxicity criterion. In 1997, toxicity units for these seven pesticides declined to just under 119 million, or about a 19 percent decline. The reduction in toxicity units on an industry-wide per acre planted basis was about 14 percent, and represents a significant shift away from higher-risk fungicides during a season when late blight pressure remained serious throughout most of the production region. Indeed, fungicide use per planted acre went up 10 percent, the equivalent of about one additional fungicide application per acre.

Placing Wisconsin's Accomplishments in Perspective

The accomplishments of Wisconsin growers are even more remarkable in contrast to national trends, especially in managing insects. Table 4 presents a comparison of pesticide toxicity unit levels nationwide and in Wisconsin in 1995 and 1997. These data are presented graphically in Figure 1.

Table 4. Wisconsin and National Trends in the Toxicity of Pesticides Used in Potato Production: 1995 to 1997

	Herbicides, Insecticides, and Fungicides		
	1995 Toxicity Units Per Planted Acre	**1997 Toxicity Units Per Planted Acre**	**Percent Change 1995 to 1997**
National	1,763	2,051	**16%**
Wisconsin	2,265	1,810	**-20%**
	Insecticides		
	1995 Toxicity Units Per Planted Acre	**1997 Toxicity Units Per Planted Acre**	**Percent Change 1995 to 1997**
National	825	878	**6%**
Wisconsin	594	228	**-62%**
	Fungicides		
	1995 Toxicity Units Per Planted Acre	**1997 Toxicity Units Per Planted Acre**	**Percent Change 1995 to 1997**
National	753	1,009	**34%**
Wisconsin	1,541	1,477	**-4%**

Wisconsin reduced use of high-risk insecticides by over 60 percent in a year when national insecticide toxicity units per acre went up 6 percent. Toxicity units associated with all herbicides, insecticides and fungicides applied in Wisconsin fell 20 percent between 1995 and 1997, but rose 16 percent nationwide. Likewise in the case of fungicides, Wisconsin reduced fungicide toxicity units 4 percent in a period when the national trend was up sharply, rising 34 percent.

Why and How Reductions were Achieved

Six factors worked together in bringing about rapid change in pest management systems and pesticide use patterns in Wisconsin, particularly in the area of weed and insect pest management:

1. IPM expands profit margins by avoiding unnecessary pesticide applications and reducing pest pressure through a variety of means, some of which entail little or no cost. Both University researchers and WPVGA helped growers learn how to identify the bottom-line consequences of IPM. As evidence mounted that IPM-innovators were saving $20.00 to $30.00 per acre, more growers started exploring their options for moving along the IPM continuum.
2. In routine trials and special studies, university scientists documented the slipping or poor efficacy of some products, and issued clear guidance to farmers to reduce or avoid their use. The commodity association amplified the message to growers in its publications and during educational events, and also pointed out the opportunity to reduce pesticide risks by avoiding use of less effective, high-risk materials.
3. Cropping system trials and other research documented options to reduce the pounds of active ingredient applied per acre to well below labeled rates while retaining acceptable levels of control. Strategies to cut rates without sacrificing efficacy were widely discussed and promoted in grower meetings.
4. On a growing percent of farms, border sprays or partial field applications were made in managing the Colorado potato beetle, coupled with cultural practices that reduce beetle survival and movement from field to field.
5. Efforts to manage resistance and diversify control options lead to the incorporation of imidachloprid (Admire) into the system. The approximate $20.00 increase in per acre treatment costs was justified partly by enhanced safety for applicators, farmers and their families, and partly by Admire's capacity to control additional pests.
6. Innovative applications of global positioning systems and precision farming techniques to identify variability in pest pressure, make spot sprays and more effectively time applications to achieve maximum efficacy with minimal applied product.

C. Lessons Learned

As the Environmental Protection Agency moves forward with implementation of the Food Quality Protection Act (FQPA), government agencies, grower groups and environmentalists are working to assure that the public health gains envisioned by the FQPA are achieved without imposing severe burdens or costs on farmers. Wisconsin potato industry accomplishments show what can be accomplished through concerted effort and teamwork. Key insights are applicable elsewhere.

IPM Adoption Reduces Reliance on Pesticides

More than any other factor, strong interest among growers and years of WPVGA and university effort in developing and promoting new IPM practices and systems made possible the recent significant reductions achieved in the toxicity of pesticides applied on Wisconsin potato farms.

Wisconsin potato IPM is much more than the sum of its parts. It is a science and knowledge-driven approach to managing biological interactions and growth cycles in farm fields. Pests are managed as one component within farming systems, drawing on an array of tactics and tools to keep populations below damaging levels. Pesticides play a role, but do bear the full burden in managing pests, as they often do in some other states.

Since the early 1980s Wisconsin potato growers, in conjunction with an interdisciplinary team of researchers from the University of Wisconsin, have developed and refined a computer-based potato crop management system called WISDOM. The system helps farmers integrate diverse information in sharpening decisions regarding pest management interventions – whether and when to apply a pesticide, for example, to reduce populations of the Colorado potato beetle.

WISDOM incorporates and assesses data on soil temperature, plant age and growth stage, humidity, levels of pest populations, and plant growth patterns in order to make prescriptive rather than routine calendar pesticide applications. Crop rotations have lengthened, improving soil quality and lessening the intensity of pest pressure. Finally, growers, crop consultants, extension agents, and processors have banded together in a commitment to crop scouting that covers over 90 percent of Wisconsin potato acreage. Scouting helps ensure that pesticide applications are made only when and where they are needed, thereby reducing overall pesticide use.

Key Importance of Resistance Management

The dramatic decline in toxicity units made possible by the introduction of Admire, and other reduced risks pesticides, can be sustained only if new tools are managed systematically within biointensive IPM systems to limit the emergence of resistance. Two major insect pest management tools that fit well into IPM systems – Admire and *Bt* – are both in some jeopardy to resistance if not used properly. For this reason Dr. Jeff Wyman and other University of Wisconsin entomologists have placed great emphasis for years on resistance management.

The same need to manage resistance proactively will arise as other biopesticides are registered and gain a place in pest management systems. Most biopesticides are much more selective in their mode of action, which is a plus because it reduces adverse impacts on non-target organisms, but also a negative since this trait also heightens the risk of resistance. For years, the University of Wisconsin IPM research team has placed great emphasis on the aggressive management of resistance. Growers have responded positively, following recommended practices. For this reason resistance has done little to erode the efficacy of the wide array of pesticides that can be used to manage the Colorado potato beetle. It will be increasingly important to maintain this focus as new pesticides enter the market.

Commodity Group Leadership Can Accelerate Change

The decisive reduction in reliance on high-risk pesticides in Wisconsin was no accident. The ability and willingness of WPVGA to work with all key components of the industry in setting clear environmental goals, and then working together to achieve them, is a great source of strength for the industry.

The Central Wisconsin Farm Credit Service is among the key players WPVGA drew into the project. By educating Farm Credit leaders and loan officers about the economic advantages of IPM to the industry and region as a whole, as well as individual grower profit margins, lenders came to view IPM as a positive form of risk-taking. Growers who displayed sophisticated knowledge and commitment to IPM came to be seen as valued industry leaders.

Setting tangible goals for risk reduction, strong university IPM-team involvement and commodity association leadership clearly has made a major difference in how swiftly reduced risk alternatives has been adopted in Wisconsin. The best evidence of the WPVGA's impact is the dramatic drop in the use of two high-risk insecticides that the association targeted well before the growing season. The OP insecticide methamidophos (Monitor) and the chlorinated hydrocarbon endosulfan (Thiodan) accounted for 63 percent of the toxicity units stemming from Wisconsin potato insecticide use in 1995. WWF had compiled data showing that these pesticides pose an unusually broad array of risks to people, aquatic organisms, wildlife and beneficial organisms, and hence WPVGA openly called upon its members to use other alternatives. The response was unexpected.

Monitor use in Wisconsin dropped from 69,000 pounds applied on 54 thousand acres in 1995, to just 17,000 pounds on 17,100 acres in 1997. The trend was opposite nationwide – Monitor was applied to 29 percent of national acreage in 1996 and 36 percent in 1997. Reliance ballooned in a few states – more than doubling.

Thiodan was an equally important insecticide in 1995 in Wisconsin, with about 65 percent of acres treated with 60,000 pounds. Recent research and new IPM techniques led WPVGA to advise growers to stop applying Thiodan altogether, a recommendation strongly criticized by the pesticide's manufacturer. Acres-treated with Thiodan dropped to just 10,000 and only 10,000 pounds were applied. Again, the nationwide trend in use was up – 10 percent of acres treated in 1996, rising to 14 percent in 1997.

Safer Chemistry Can Make a Difference

The availability of an effective, affordable, and much safer insecticide for Colorado potato beetle control – imidachloprid, or Admire – made possible much of the wholesale shift away from the much higher-risk OPs and carbamates that were used widely in 1995. NASS chemical use survey results show that growers in some states appear much more interested in taking advantage of the opportunity to shift to safer pesticides than in others.

This observation has important implications for FQPA implementation – in many key potato producing states, the availability of safer alternatives is not necessarily going to result in a move away from older, high-risk chemistry. There is a continued role for regulation in assuring consistent progress in reducing pesticide risks that keeps pace with the availability of safer products and better options.

In the area of plant disease control, Wisconsin growers did not have any important new fungicides to lessen reliance on older, higher risk products. Nor did any new resistant varieties or biological control techniques become available. As a result, little progress was made in reducing fungicide toxicity units.

Prospects for Further Progress

Fortunately, growers are likely to have new options in 1999 and beyond to further reduce the toxicity units stemming from pesticide use in the Wisconsin potato industry.

Growers are most in need of new plant disease management options. A promising new Zeneca biofungicide, Quadras, is expected to gain full registration in time for use in the 1999 season. It is the first in a new class of chemistry, and is derived from a natural fungus. Active against all four major families of fungi, some people predict that Quadras, and related compounds, will become the "EBDC's of the next century." (The EBDC's are a major group of fungicides including mancozeb, maneb, ziram, and metiram).

In Wisconsin and most states, an acre-treatment with Quadras will replace an acre-treatment with maneb, mancozeb, or chlorothalonil. Given the lower rate of application for Quadras, and its very low toxicity factor value, we project at least a 50-fold reduction in the toxicity units per acre treated. The biopesticide company AgraQuest, based in Davis, California, also has a promising biofungicide almost through the EPA registration process that has shown good results in the control of several potato diseases. Other bio-based fungicides are in various stages of development, and new options are also expected to emerge from the efforts of plant breeders who are working to develop resistant varieties.

In additional, recent research and manufacturing innovations have allowed Zeneca to remove the cancer-causing impurity from the major potato fungicide chlorothalonil. The EPA is reviewing new toxicology data on technical material made using the new manufacturing process and is expected to change the classification of chlorothalonil from a B_2 carcinogen to a non-oncogenic classification. This will reduce by about one-quarter the toxicity units associated with an acre-treatment of chlorothalonil.

Further progress is also expected next year in reducing the toxicity units associated with insecticide use because of the registration of several promising new active ingredients, especially the Novartis insecticide pymetrozine, or FulFill. This new insecticide is also the first in a new family of chemistry. It is highly selective, and will help growers build up populations of beneficial organisms, a necessary step in order to progress further along the IPM continuum.

FulFill is a direct replacement for the OP Monitor, and is likely to further reduce, and perhaps even end Monitor use in Wisconsin. FulFill is applied at about one-tenth the rate of application as Monitor. In addition, its toxicity factor value is 55 compared to Monitor's at about 200. As a result, there is close to a 400-fold reduction in toxicity units when a farmer applies two applications of FulFill instead of a single application of Monitor.

In order to provide growers new tools to manage pests in step with FQPA implementation, timely registration actions by the EPA will become increasingly vital. In the potato industry, new products are also needed in order to diversify pest management systems – a key step in limiting the danger of resistance. Managing potato insect pests in the late 1990s is clearly easier and safer than 10 years ago. In just a few more years growers are also likely to have badly needed new fungicide alternatives.

Indeed, the prospects look excellent for new IPM options and safer alternatives. Woven together within biointensive IPM systems, Wisconsin potato growers can make steady progress along the IPM continuum and take a major step toward sustaining the profitability of potato production in the Central Sands for generations to come.

Appendix 1: Calculating Pesticide Toxicity Units

The project developed a multiattribute index that allows comparison of pesticide active ingredient toxicity across several dimensions of potential impact. The index is composed of four major components: acute mammalian toxicity (AM), chronic mammalian toxicity (CM), ecotoxicity (ECO), and impacts on biointensive IPM systems (BioIPM). The general equation used to calculate the toxicity factor value for a given pesticide is:

$$\text{Value for Pesticide}_x = (a)AM_x + (b)CM_x + (c)ECO_x + (d)BioIPM_x$$

Where, (a), (b), (c), and (d) are weights assigned to each component index.

Guidance was sought from the WWF-WPVGA Advisory Committee and technical consultants regarding what weights to use for the purpose of establishing baseline multiattribute toxicity units subject to project risk reduction goals. Several different formulas were calculated and explored, leading to a decision to adopt the following weighting scheme –

$$\text{Wisconsin Project Risk Index Pesticide}_x = (0.5)*AM_x + CM_x + ECO_x + (1.5)*BioIPM_x$$

Further details on this method and data sources are available in the methodological paper "Monitoring Progress Toward Pesticide Risk Reduction Goals in the Wisconsin Potato Industry." WWF or WPVGA will provide a copy upon request.