5th IPM Symposium: "Delivering on a Promise"

Evaluating Risk Reduction: "Real People/Real Data"

April 5, 2006

“Reducing Workers’ Risk to Pesticides by Using Low-Risk Pesticides in Blueberry Production”

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Fifty+% of blueberry acreage is hand-harvested, creating a potential for worker exposure to broad-spectrum insecticide residues. We intend to provide EPA field exposure data comparing conventional to reduced risk IPM programs to refine their risk assessments to ensure worker safety.

Risk =
Toxicity x Exposure

Hypothesis:

The use of reduced risk pesticides leads to a significant decrease in worker exposure to pesticides and a greater safety factor for workers hand harvesting blueberries.

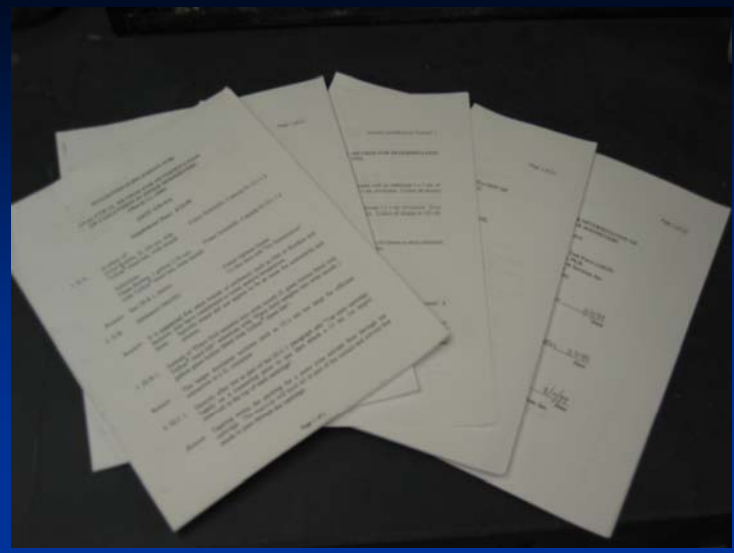
Objectives

The objectives of the study were to:

1). Compare in conventional and reduced risk control programs the levels of pesticide residues on treated leaves, fruit and workers; and

2). calculate for imidacloprid (Provado) and phosmet (Imidan) the Margin of Exposure or safety factor for each product.

Methods



Using EPA protocols, foliar dislodgeable residues, fruit residues, and worker exposure samples were taken and analyzed for residue levels.

From this data, Transfer Coefficients and Margins of Exposure were calculated measuring the risk to workers.

Methods

For two summers, two adjacent fields of blueberries in west central Michigan were used as the test site. Each was treated early in the morning. The conventional block had phosmet (Imidan 70WP) applied at 1.33 pounds/acre, and on the IPM plot imidacloprid (Provado 1.6 F) was applied at 8 ounces per acre. Three days after application, four volunteers harvested fruit for four hours in each field.

CONSENT TO BE A RESEARCH STUDY SUBJECT

Title of Project:
Reducing Workers Exposure to Pesticides by Implementing
Integrated Pest Management Practices in Blueberry Production

PART B – DERMAL EXPOSURE

1. PURPOSE OF RESEARCH

Michigan State University and the Michigan Department of Agriculture are conducting a study to find out how much pesticide rubs off pesticide-treated leaves onto clothing and skin while harvesting blueberries. The information may be used by EPA to make refined risk assessment decisions about when it is safe to enter a field after it has been sprayed. Participation in the study is voluntary.

You are being asked to participate in the study because in your regular work, you routinely perform the field activity required for this particular study.

During this study you will be entering fields that have been treated with pesticides, some that have been used traditionally for blueberry production or newer approved pesticides products. In either case, you will NOT be asked to re-enter a field before the legal re-entry interval in compliance with EPA safety standards.

2. TIME ESTIMATE

You will be performing your regular work activities (harvesting fruit for 3-4 hours), but this study could take as much as an additional hour of your time for study preparation and change of clothing.

Prior to the study, "Informed Consent" forms were reviewed and approved by MSU's University Committee on Research Involving Human Subjects (UCRIHS). Since the harvesters were Hispanic, a Spanish translation of the form was read to each worker. Workers signed and were given a copy for their records.

Cotton inner and outer garments (dosimeters), pre-washed in methanol to remove starches, were worn during harvest and analyzed for pesticide residues to determine exposures.

Dosimeters

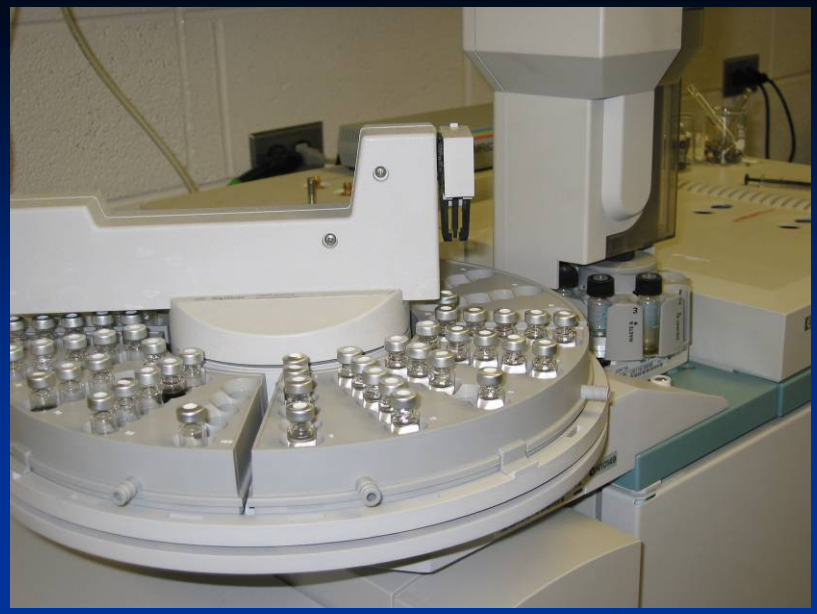
Volunteers donned the dosimeters inside privacy tents in the field prior to working. After working, they removed their dosimeters inside the tent with the assistance of the Co-PI to minimize any cross contamination. After field exposure, dosimeters were cut into sections, wrapped in aluminum foil, placed in a cooler on dry ice, and transported to the laboratory for storage until analysis.

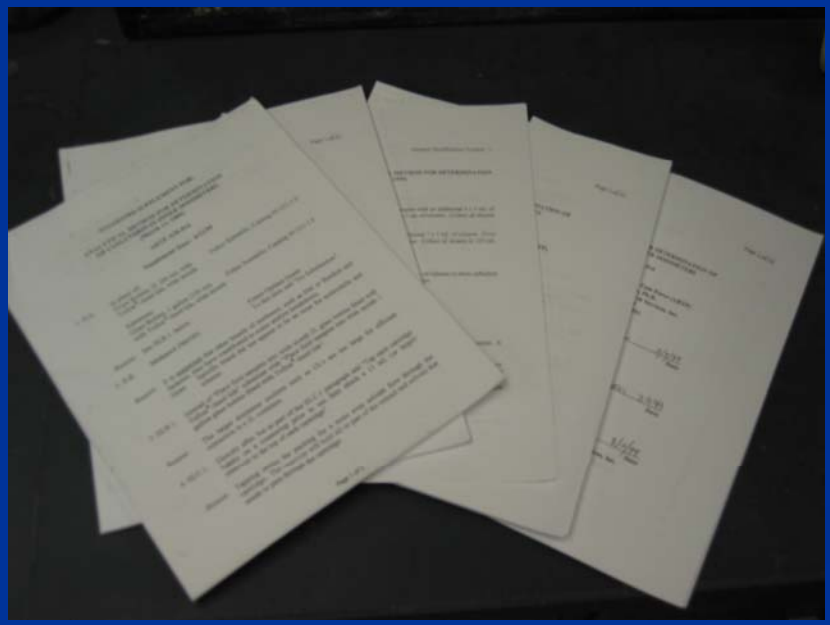
Hand washes and face and neck wipes were collected and analyzed to determine the amount of pesticides transferred to the workers after harvesting blueberries for four hours. Washes were stored in large jars, transported to the laboratory on ice, and stored in a freezer until analysis.

<u>Foliar dislodgeable residues</u> were measured by taking four replicates of 160 leaf punches totaling of 400 cm^2 leaf tissue for 9 consecutive days and analyzing the sample for residues.

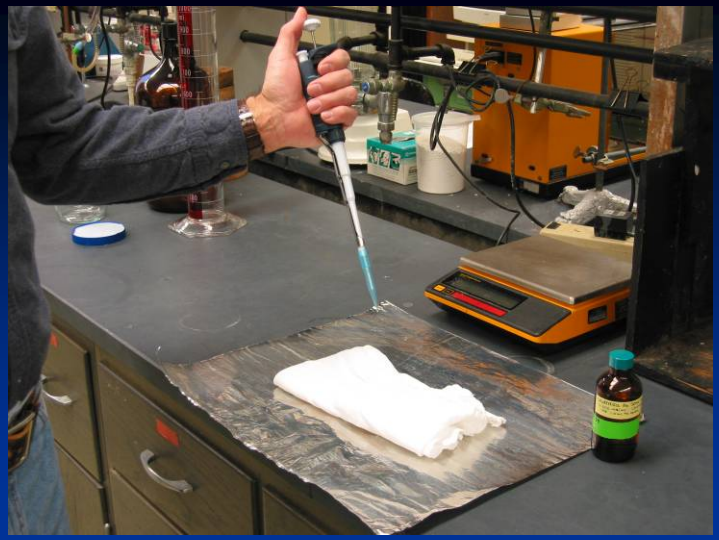
<u>Fruit dislodgeable residues</u> were measured by taking four replicates of eighty eight fruit which equated to 400 cm^2 surface area on day zero and three days post-treatment and they were analyzed for residues.

The samples were washed with a soapy solution on a shaker for 10 minutes, the rinsate water decanted and the samples were washed a second time. The rinsates were consolidated for later analysis.





After preparation, samples were analyzed using the EPA approved protocols.



Quality Control Samples

Inner and outer dosimeters, hand wash and neck wipe samples were spiked with a known amount of both products and analyzed to determine recovery accuracy.

This data is needed to accurately account for any residue losses or transformation that may occur during the conduct of the study, and to determine the extraction efficiency and laboratory recovery rates.

EPA Data Quality criteria expects percent recovery data in the range of 70% to 120%.

Dosimeters are sectioned to determine deposition on different parts of the body, then mitigation measures can be taken to reduce the total body exposure.

2004 Inner & Outer Dosimeters.

Phosmet *µg*/sample/4 hours exposure

Section	Outer (n=4)	Inner (n=4)
Front Torso	908	87
Rear Torso	465	54
Upper Arm	520	106
Lower Arm	1750	402
Upper Leg	1950	31
Lower Leg	760	12
Total	**6353**	**692**

= 9.8% penetration

Imidacloprid *µg*/sample/4 hours exposure

Section	Outer (n=4)	Inner (n=4)
Front Torso	32.1	0.5*
Rear Torso	5.5	0.5*
Upper Arm	21.7	4.6
Lower Arm	11.9	0.5*
Upper Leg	31.9	5.6
Lower Leg	11.6	2.4
Total	**114.7**	**14.1**

= 10.8% penetration

** Limit of Quantification for inner dosimeters*

2005 Inner & Outer Dosimeters.

Phosmet *µg*/sample/4 hours exposure

Section	**Outer** (n=4)	**Inner** (n=4)
Front Torso	113	31
Rear Torso	145	46
Upper Arm	76	9
Lower Arm	78	17
Upper Leg	71	24
Lower Leg	275	10
Total	**738**	**135**

Imidacloprid *µg*/sample/4 hours exposure

Section	**Outer** (n=4)	**Inner** (n=4)
Front Torso	21	9
Rear Torso	17	8
Upper Arm	12	8
Lower Arm	18	5
Upper Leg	19	14
Lower Leg	15	8
Total	**103**	**52**

** Limit of Quantification for inner dosimeters*

Face/neck wipe residues

Compound	Year	Mean *ug*/sample
Phosmet	2004	8.3
Imidacloprid	2004	*
Phosmet	2005	*7.3*
Imidacloprid	2005	6.6

** residues were below the limit of quantification.*

Face and neck wipes residues of phosmet were present in all samples at low levels. Imidacloprid's residue profile showed that it was not detected in any sample in 2004, but was in all samples in 2005 at low levels.

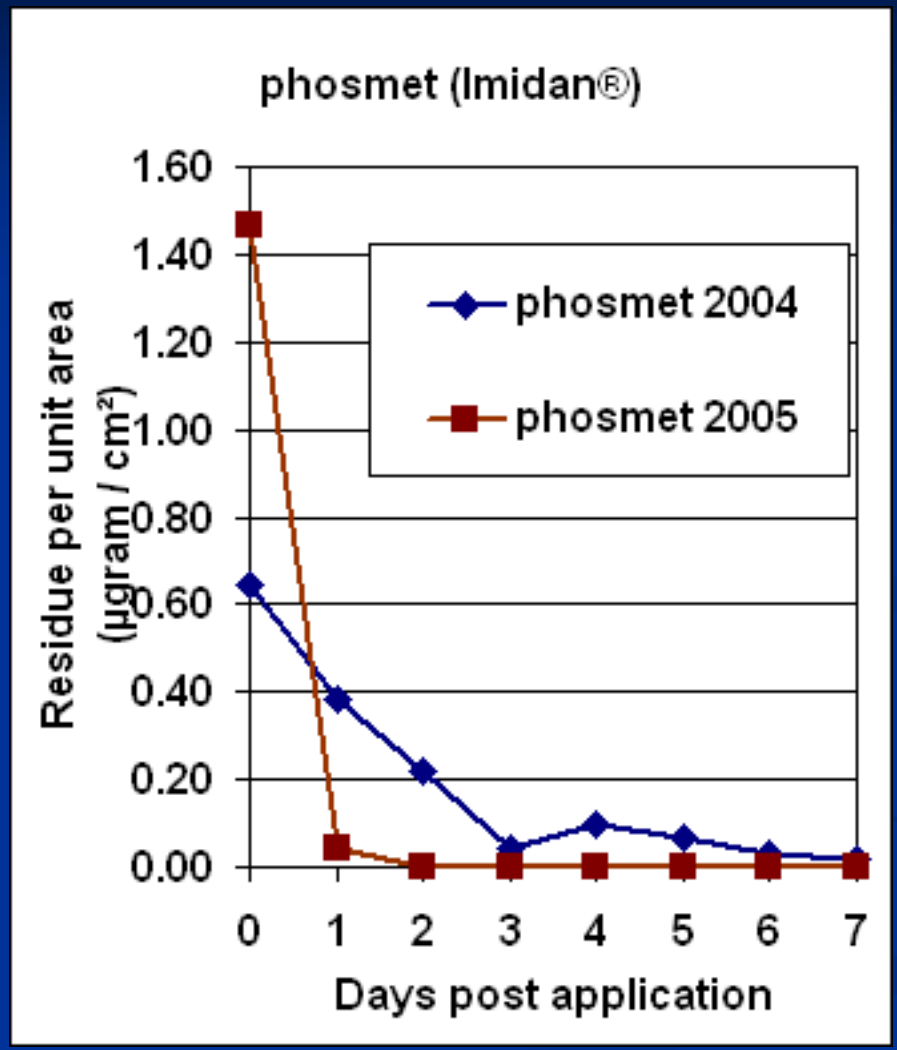
Hand wash residues

Compound	Year	Mean *u*g/sample
Phosmet	2004	775
Imidacloprid	2004	1.6
Phosmet	2005	31.7
Imidacloprid	2005	25

The hand wash data shows that for phosmet, in 2004 over 50% of the exposure was on the hands and in 2005 it was 20%.

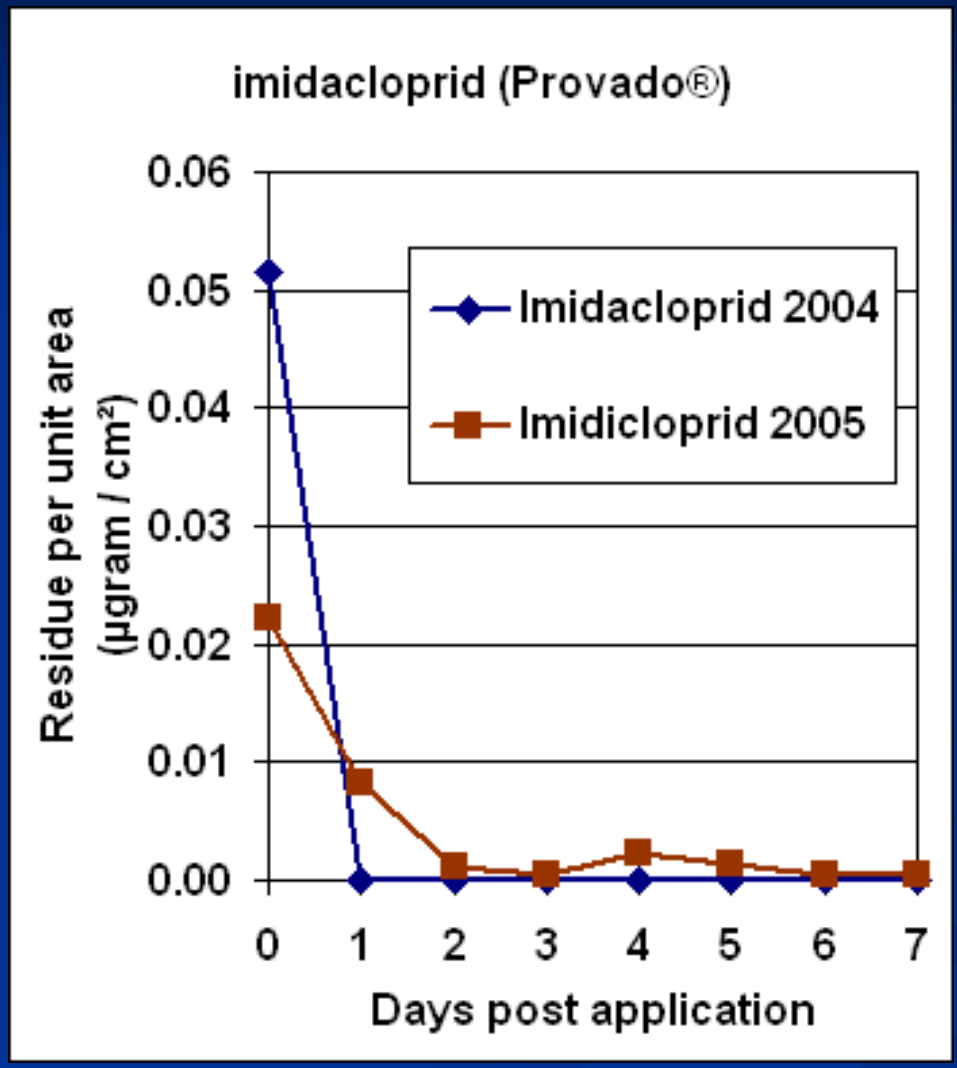
For imidacloprid, in 2004 10% of the exposure was on the hands and in 2005 30% of the residues were on the hands.

Phosmet foliar residue decline – 2004 and 2005



A spray of phosmet made to the traditional plot had residues which steadily declined for seven days.

Imidacloprid foliar residue decline – 2004 and 2005



A spray of imidacloprid made to the IPM plot had residues which declined rapidly within one day.

Fruit residues

Compound	Year	Mean *u*g/sample
Phosmet	2004	126
Imidacloprid	2004	0.6
Phosmet	2005	9.4
Imidacloprid	2005	4.5

There were very low levels of imidacloprid on the berries. This supports the data from the Dislodgeable Foliar Residues that the material rapidly moves from the surface.

Phosmet had higher levels of residues showing that the material is available for transfer during harvesting.

Data Analysis

Formula for dose calculation from experimental data:

$$\text{Dose} = \frac{(\text{Dermal Exposure})(\text{Exposure Time})(\text{Dermal Absorption})}{(\text{Body weight})} = \text{X ug/kg/day}$$

Dermal Exposure = Inner Dosimeter + Face and Neck Wipe + Hand Wash
Exposure Time = 8 hour work day
Dermal Absorption = % absorbed through skin (from literature)
Body Weight = Actual average weight of workers

Data Analysis

Margin of Exposure (MOE)

The MOE is the NOEL divided by the dose. This indicates the margin of safety between the exposure dose and the experimental level at which no health effect would be expected to occur. EPA's policy for risk assessment sets the MOE at 100.

Phosmet: The NOEL is 15 mg/kg/day
Imidacloprid: NOEL is 1000 mg/kg/day

$$MOE = \frac{NOEL}{Dose}$$

Risk =

Toxicity x Exposure

Results

Total exposure resulted in a margin of exposure of 220 for phosmet and 12,463 for imidacloprid, all above the 100X safety standard set by EPA.

Conclusions

- Foliar and fruit residues nearly dissipated within one day in the imidacloprid plot.

- In the phosmet plot, all residues decreased steadily for 7 days when there was little rain to wash off residues.

- Most of the exposure was on the hands of workers manually harvesting fruit for four hours.

- The penetration of the pesticides from the outer to the inner dosimeters averaged 10.9% for all subjects.

- The margins of exposure were 220 for phosmet and 12,463 for imidacloprid.

- This study confirmed the hypothesis that reduced risk pesticides provided a greater margin of exposure for workers reentering fields post-application to harvest fruit.

Future Plans

1. Repeat the study with:
   - additional subjects,
   - multi-state sites.

2. Provide data to EPA for refined risk assessments.

3. Continue outreach efforts.

Any Questions?

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