

**WSDA SPECIALTY CROP BLOCK GRANT PROGRAM
FINAL PERFORMANCE REPORT**

OCTOBER 1, 2010 – SEPTEMBER 30, 2011

Grant Agreement Number: **K513**

Report Submitted By: **Jay F. Brunner**

Project Title: **APPLE IPM TRANSITION PROJECT**

Activities Performed

Briefly summarize activities performed, targets, and/or performance goals. This project is somewhat different from other projects funded by the Specialty Crop Block Grant Program (SCBGP) in that it represents an ongoing effort over the last four year – 2008-2011. The first two years of this project were funded by the Washington State legislature through an allocation to the Washington Tree Fruit Research Commission, which in turn funded the Pest Management Transition Project (PMTP). In the last two years the Apple IPM Transition Project (AIPMTP) was supported by the SCBGP through funding of two one-year projects. It would be an injustice to the history of this effort to report on the impact of one year of what in reality has been a four-year project. However, I have endeavored to make clear the accomplishment for the current project as they relate to the plan of work that the SCBGP funded while at the same time linking the current year's accomplishments to accomplishments and impacts over the last four years.

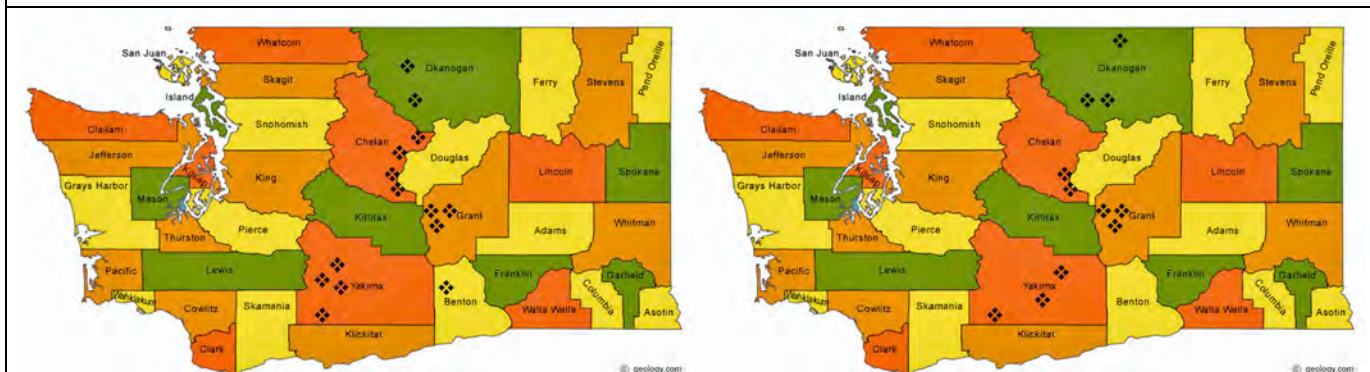
Context. The genesis of the PMTP (current AIPMTP) was national regulatory action limiting or eliminating the use of certain pesticides that were deemed of high risk to farm workers and the environment. A principal driving issue was the EPA's decision to phase-out the use of azinphosmethy (AZM) in tree fruit production. AZM has been the single most used insecticide in apple production over the last four decades. Its primary use has been as a control for the key pest of apple, the codling moth, aka "the worm in the apple". Replacements for AZM and other insecticides in the same class, the organophosphates (OPs), had been or were in the process of being registered by the EPA. WSU had been conducting research on these OP-alternatives for several years. The PMTP funding provided the resources to launch an education effort targeting the apple industry on how to implement best practices using OP-alternatives. In addition, the PMTP funding provided the opportunity to connect with farm workers and environmental groups to help them understand the benefits derived from tree fruit growers transitioning to OP-alternative insecticides. A final report of the PMTP can be found on the AIPMTP web site at http://pmtip.wsu.edu/downloads/PMTP_Final_Report.pdf.

It was clear that the PMTP project made great strides in helping the WA tree fruit industry implement best practices using OP-alternatives between 2008-2009. The project also provided needed baseline data about practices and perceptions of growers and crop consultants, which were to provide evidence that the original goals were being met. Two years was not sufficient time for the PMTP to fulfill all of its original goals. The SCBGP provided an opportunity to request additional funding to complete the original vision. Through the support of the WA tree fruit industry the SCBGP provided an additional two years of funding (2010 and 2011) and this report reflects the culmination of four years of effort, accomplishments, and impacts with emphasis on the currently funded project.

PMTP. Education to WA apple producers occurred in several different formats; winter meetings, newsletters, and field days, but the primary focus over the first three years of the project was on self-selected groups who committed to more intense learning and sharing of experiences. These groups were termed Implementation Units (IUs). IUs consisted of growers/managers and consultants (136 total), geographically distributed throughout the apple growing region, and representing over 94,000 acres of apple production (55%) in WA

(Fig. 1). These groups met 3-4 times a year in 2008 and 2009. In 2010 the number of meeting declined in frequency and were held based on the expressed needs of the groups.

Figure 1. Implementation Unit Geographical Distribution (2008 left – 2009 right).



The **AIPMTP (PMT) Handbook** served as the primary educational tool for IU members, but was widely distributed (over 600 copies) to the entire industry, including a Spanish language version. The PMTP Handbook is available on-line at <http://pmt.wsu.edu/handbook.html>. It will be maintained and updated as a legacy of the current project by sustaining and continuing the effort of helping apple producers adopt new IPM technologies.

Web resources. Since the beginning of the PMTP and throughout the AIPMTP we have maintained a high quality and up to date web presence. The projects home page is at <http://pmt.wsu.edu/index.html> from which a person can access all the educational information developed by the project, find progress reports, access the handbook, eNewsletters, and reference tools. This final project report will be added to the web page resources.



Field days. In the first two years of the project (2008-2009) we held several field days where growers and consultants could share in the educational activities, such as monitoring pests, sprayer calibration and biological control, which related to the goals of the project. In the last two years we did not formally hold field days but participated in field days organized by other groups.

Pest Management Fruit School. In 2009 we held a WSU Pest Management Fruit School where we covered the fundamentals of IPM and how to transition to use of new (OP-alternative) pest control technologies using best practices. The fruit school was a two-day event in which 183 individuals participated at four locations. We used modern electronic delivery technology to distribute the fruit school to three remote

locations in real time.

Farmworker Outreach. A major effort of the AIPMTP project was to reach farm workers who are impacted by pest control activities in orchards. We worked with 30 individuals and organizations to understand the concerns and knowledge of the farm worker community and how best to reach them. Bilingual project personnel attended farm worker health fairs where we sponsored activities that helped get the word out on the relative safety of pesticides used in orchards, especially the new ones, OP-alternatives, that posed very little risk to farm workers and their families. A significant outcome of these activities was the development of a handout/poster that in a very clear way showed relevant information in ways the farm workers could

understand. This poster (image seen at right) can be downloaded from our web site (<http://pmtip.wsu.edu/downloads/PesticideLabelPoster.pdf>) and has been in high demand by growers and managers as a means to simply and clearly tell farm workers and applicators about the new products they are using for pest control and why they can now reenter the orchard after only 4 hours compared to 3 to 14 days when older insecticides were being used.



Assessment and Documentation. The PMTP was critical to the establishment of baseline data on perceptions and practices of apple growers and crop consultants regarding the transition away from old and to new IPM technologies. Over four years we implemented four major surveys of apple growers/managers (2008, 2010) and crop consultants (2007, 2009). Results of these surveys form the basis by which we have documented the project's ability to meet established goals. The project also introduced an audience participation technology, TurningPoint™. This technology allowed us to query different audiences with specific questions to determine what they knew and what they learned from participating in project activities. The TurningPoint™ technology is now used throughout the fruit industry by extension and other industry groups as a tool to gather needed information and to get feedback (anonymous) from clientele.

Comparison of the goals established with the actual accomplishments

The goals (objectives) of the three phases of the AIPMTP (AMTP) are provided below. The first is from the PMTP project conducted in 2008 and 2009. The second are the goals from the first SCBGP and the last are goals of the current funded SCBGP. Boiling these goals down they fall into three categories; 1) enhance and increase adoption of new IPM technologies and practices, 2) leave a legacy that will transcend the project, and 3) document how the project has changed perceptions and practices. I have summarized the accomplishments of the project as it evolved through time, making specific reference to the current project.

The goals of the original PMTP (2008-2009) were to:

1. Enhance understanding of new IPM technologies through educational programs and communication of research-based knowledge
2. Increased adoption of new IPM technologies through strategies that include the sharing information on successes and failures and communicating with all stakeholders on project progress
3. Document changes in practices, attitudes, and perceptions of growers, farm labor, and stakeholders

The goals of the first AIPMTP funded by the SCBGP (2009-2010) were to:

1. Speed the adoption of new IPM technologies through educational programs and communication of research-based knowledge
2. Improve real-time pest management decisions through full use of the web-based WSU Decision Aid System (DAS)
3. Document and communicate changes in practices, attitudes, and perceptions of growers, IPM consultants, farm workers, and other stakeholders

The goals of the current AIPMTP funded by the SCBGP (2010-2011) were to:

- 1. Finalize efforts on adoption of new IPM technologies through educational programs and communication of research-based knowledge**
- 2. Complete legacy products that will transcend the life of the project, and**
- 3. Conduct final documentation activities demonstrating changes in practices, attitudes, and perceptions of growers, IPM consultants, and farm workers.**

Adoption of new IPM technologies and practices. The tree fruit industry faced a major challenge when in 2006 the EPA announced the phase-out of AZM by 2012. The initial survey of apple growers (2008) showed that the primary barriers to the adoption of OP-alternatives for codling moth control were that they would be too expensive, would not be effective (as old products), and would cause other pest problems. In a follow up survey (2010 – a primary objective of the current project) these perceived barriers had not changed (Table 1). The 2009 survey showed the crop consultants considered the same barriers as most important but a higher proportion were concerned about higher costs of OP-alternatives compared to growers and a lower proportion were concerned about efficacy (Table 1). These results are not surprising since research had shown that OP-alternatives were less efficacious than products they were replacing and some had been identified as causing pest problems. Growers and consultants soon learned that the new technologies cost 1.5 to 3 times more on a per acre basis than the old technologies.

Table 1. What barriers do you face in using the alternatives to AZM (Guthion) to achieve acceptable control of codling moth? (Question D7 in surveys)

Barriers to adoption of OP-alternatives for control of codling moth	Grower survey		Consultant survey	
	2008	2010	2007	2009
Alternatives are too expensive	31%	33%	NA	41%
Alternatives are not as effective	28%	26%	NA	19%
Alternatives cause other pest problems	8%	9%	NA	12%

In addition to questions about barriers to the adoption of OP-alternatives we asked growers and crop consultants a series of opinion questions with responses ranging from strongly agree to strongly disagree. A sample of responses is shown in Table 2.

Table 2. Indicate the extent to which you disagree or agree with each of the following statements (Question D8 in surveys)

Statement	Agree or strongly agree with statement			
	Grower survey		Consultant survey	
	2008	2010	2007	2009
The cost of codling moth control will be higher after the Guthion phase-out	91%	91%	98%	93%
Control of codling moth will be more difficult after the Guthion phase-out	68%	68%	70%	64%
Phasing out Guthion will make tree fruit production riskier for growers	60%	62%	62%	62%
Growers have effective alternatives to Guthion at their disposal	49%	51%	65%	77%
Phasing out Guthion will provide me with new apple marketing opportunities	10%	15%	15%	24%
Phasing out Guthion will encourage growers to use safer pesticides	62%	62%	68%	70%

Comparing responses to these statements from grower and consultant surveys showed pretty consistent agreement, with no, or very little, change between the two years separating the surveys. Most growers and consultants felt that the cost of codling moth control would increase after the AZM (Guthion) phase-out and that control of this pest would be more difficult. Most growers and consultants agreed that phasing out AZM would make tree fruit production riskier (more uncertain). Growers were not as sure as consultants about the availability of effective AZM alternatives, probably because consultants were more informed about research on these products than most growers. It is also encouraging that more consultants agreed with this statement in 2009 compared to 2007. Few growers or consultants thought the phase-out of AZM would provide new market opportunities for apple sales, but most agreed that the phase-out of AZM would encourage the use of safer pesticides. The above examples of how perceptions either do not change over time or change very slowly has some basis in reality. For example, it is not surprising that growers, as well as consultants, agreed with the statement that codling moth control costs would increase since this has indeed been their reality.

When asked about **changes in practices** we saw some differences in grower responses between 2008 and 2010 and consultant responses between 2007 and 2009. There was a 9% decrease in the use of OP insecticides reported by growers (2008 to 2010), however, there was a 40% decrease in the recommendations of consultants for use of OPs (2007 to 2009), Table 3. By contrast growers did not report any change in the use of OP-alternatives (Table 4), which is informative since they indicated a decline in use of OP insecticides for codling moth control (Table 3). We did not ask the same questions in the 2007 consultant survey so only have data from the 2009 survey in which 76% indicated that they had increased recommendation for use of OP-alternatives for codling moth control over the previous three years (Table 4). In 2008 the percent of growers using 2 or 3 applications of AZM was 73% but this had declined to 63% in 2010. These data support other data that show apple growers are using less OP insecticides and transitioning to use of OP-alternatives. But were changes in practices effective? In 2008, 57% of growers reported that fruit injury from codling moth had remained about the same over the past three years while 17% considered that injury had increased during this same period (survey question B7). In 2010, 61% of growers reported that fruit injury from codling moth had remained about the same over the past three years while 16% considered that injury had increased during this same period. So with changes in practices there was no increase, or decrease, in crop protection from the growers perspective.

Table 3. Did your use of **OP insecticides** for codling moth change over the last three years? (Survey question B4)

Did your use or recommendations of OP-alternatives for control of codling moth over last 3-years	Grower survey		Consultant survey	
	2008	2010	2007	2009
<i>Decreased</i>	50%	59%	35%	75%
Remained about the same	40%	30%	33%	21%
Increased	6%	2%	30%	1%
Did not use or recommend	5%	9%	2%	3%

Table 4. Did your use of **OP-alternative insecticides** for codling moth change over the last three years? (Survey question B6)

Did your use or recommendations of OP-alternatives for control of codling moth over last 3-years	Grower survey		Consultant survey	
	2008	2010	2007	2009
<i>Decreased</i>	12%	14%	NA	8%
Remained about the same	36%	36%	NA	16%
Increased	47%	47%	NA	76%

When growers were asked what they knew about the AZM phase-out schedule almost all (99%) were aware of it but in 2008 only 35% knew that the last year they could use AZM was 2012. In 2010, 54% of the growers knew that 2012 was the last year they could use AZM (survey questions D1 and D2). In addition, 65% of growers in 2008 and 2010 indicated that they were in process of decreasing use of AZM (Table 5). However, between 2008 and 2010, 6% more growers said that they had stopped using AZM. While these changes might seem small they actually represent a large change in use of OP insecticides by the apple industry.

Table 5. Which of the following statements best reflects your approach to the Guthion (AZM) phase-out? (Survey question D3)

Statements	Grower survey	
	2008	2010
I am in the process of reducing my use of Guthion	65%	65%
I have already stopped using Guthion	18%	24%
I have not yet reduced my use of Guthion	14%	8%
I have never used Guthion, so the phase-out does not affect me	1%	1%

Pheromone mating disruption has been identified as a key component of an IPM program using OP-alternatives in the AIPMTP educational materials and activities. Most consultants (95-98%) recommended use of pheromones for control of codling moth. The percent of growers reportedly using pheromones went from 65% to 68% in 2008 to 2010, respectively, however, based on the total apple acres managed by respondents in 2010 we estimate that about 86% of bearing apple acres are being treated with pheromones.

We worked to encourage the tree fruit industry to use the WSU Decision Aid System as a tool to help them improve implementation of OP-alternatives in IPM programs. The use of DAS by growers increased from 37% in 2008 to 42% in 2010. Ninety-three percent (93%) of consultants reported using DAS in 2009.

What has been presented here is a small portion of the data the project has collected over the last four years. Complete results of the grower and consultant surveys can be found on the AIPMTP web site at <http://pmtip.wsu.edu/impacts.html>.

One of our major areas of outreach in the project was to the Hispanic community that worked in orchards. We took advantage of pesticide recertification classes as a way access this group and used the TurningPoint™ audience participation technology to capture responses. Because we conducted these activities over two winters, 2008-09 and 2009-10, we are able to compare some of the responses to see if our education programs were making a difference in their knowledge of the AZM phase-out and OP-alternatives. A few more of the respondents knew about the AZM phase-out, 80% versus 82%, in 2008-09 versus 2009-10, but in 2009-10, more (69%) were aware of the last year AZM could be used compared to 2008-09 when only 52% responded correctly. This audience indicated an increase in exposure to using the TurningPoint™ system from 27% to 57% between the two periods. The questions in this survey were focused more on pesticide safety than on IPM. For those interested, complete survey results can be found at our web site - http://pmtip.wsu.edu/TPsurvey2010_Sum.html.

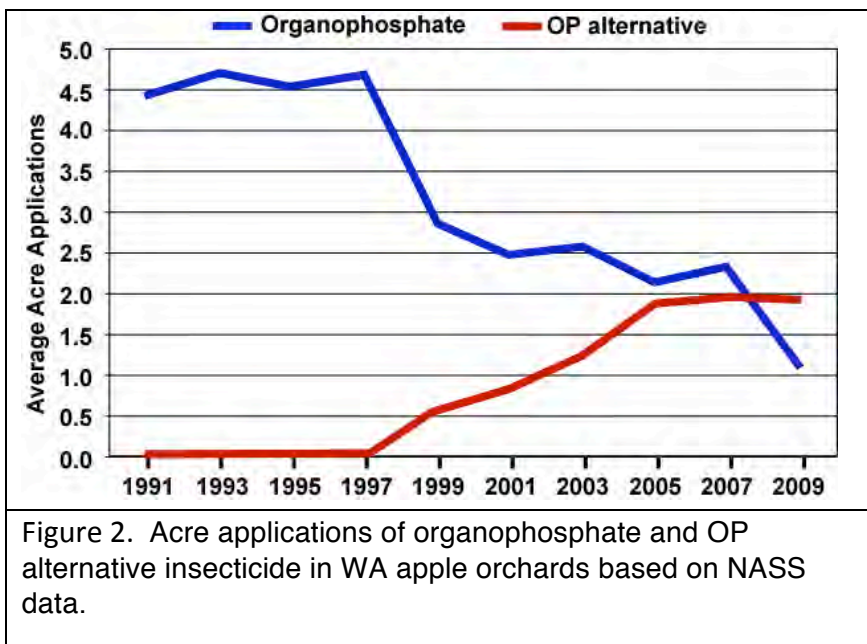
General surveys of growers and consultants provides one view of changes in perceptions and practices but we also surveyed those who participated in our IUs to see what changes they had made and what value they placed on the AIPMTP. After the first year of project (2008) we used the TurningPoint™ audience participation technology to ask some basic questions about the materials we had used in our education activities. Most rated the information presented in the IU meetings as relevant (84%), sixty-one percent (61%) said

participating in meetings influenced their IPM decisions, and 92% said they would participate in the following year. Participants felt that the AIPMTP Handbook was both relevant to their IPM decision making (91%) and the concepts were clearly presented (93%). Seventy-two percent (72%) rated newsletters as relevant to their IPM decisions and 97% wanted to receive the letters the following year. Field days were not rated as high as the other educational activities as it seemed harder for people to get away in the middle of the growing season to participate in them. Of those that responded, 70% liked the web site and thought it was easy to find information on it.

In 2011 we conducted an on-line survey of those who had participated in IUs. Most of the respondents (61%) had participated in an IU two years or more. Eighty-four (84%) percent of the respondents indicated that participating in the IU influenced their IPM decisions and 81% said the AIPMTP Handbook was a helpful resource. Sixty percent (60%) of the respondents indicated that they did **NOT** use or recommended AZM in 2011. Ninety-two percent (92%) used or recommend mating disruption (pheromones) for codling moth control and 93% used the WSU Decision Aid System. The major concern about using OP-alternatives was their high cost (28%) and that some of them caused problems with other pests (24%), but 31% said there were no barriers to using OP-alternatives. Find all the results of this survey at http://pmtip.wsu.edu/IU_2011_Survey.html.

While it is always good to have internal baseline data to document changes in perceptions and practices by a clientele group, it is also good to have independent third-party evidence that confirms changes. We followed changes in insecticide use over time for WA apple that was collected in the National Agricultural Statistics Service (NASS) pesticide use surveys. For tree fruit these data have been collected every other year since 1991. Therefore, data for pesticide use in apple in WA were available for the year prior to the start of the AIPMTP (PMTP) as well as during the project.

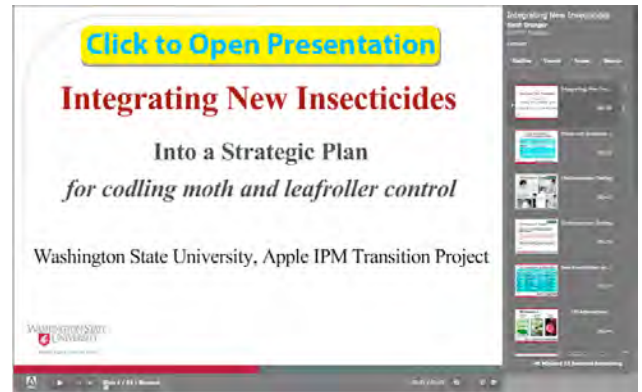
Figure 2 shows the acre applications of OP insecticides from 1991 through 2009 used on WA apple orchards. Acre application values are used to compare use of different products or pesticides groupings because newer products are used at much lower rates per acre than older products, like OPs. An acre application represents the average number of applications of a pesticide or pesticide group applied to one acre of a crop. During most of the 1990s an average of about 4.5 applications of OP insecticides were applied to each apple acre. The use of OP



insecticides declined in the last part of the 1990s due to regulatory action and to the adoption of mating disruption. Also, in the late 1990s the use of OP-alternatives began to increase as new products were registered for use on apple. The use of OP insecticides dropped dramatically between 2007 and 2009, mostly due to declines in use of AZM. This drop represented a decline in pounds of active ingredient used in apple from 499,000 pounds to 276,000 pounds. It is of Interest to note that the use of OP-alternatives did not continue to increase between 2005-09. These data independently confirm the changes occurring in use of OP insecticides in apple IPM in WA. While some of the changes are due to regulatory action much of the change

can be attributed to growers and crop consultants making proactive decisions to move to new technologies supported by good information and education delivered by the AIPMTP.

Leaving a Legacy of the AIPMTP. One of our objectives was to leave a lasting legacy for the WA apple fruit industry after this project terminates. Part of that legacy will be maintaining the web site and adding to it and evolving it as new information becomes available. Another objective of the current project was to develop and IPM manual, but with more and more information being accessed on-line we opted to develop an **on-line educational product** that captures the essence of the transition project. This on-line resource is titled



Integrating New Insecticides into a Strategic Plan for Codling Moth and Leafrollers. It is an educational training document found at http://pmtip.wsu.edu/INI_presentation.html. The image above shows what a person will see when they go to the site. This narrated presentation is about a 45 minute training session with built in quizzes that have to be passed in order to continue through the training.

Another legacy item already mentioned is the **pesticide information poster** developed to help farm workers understand the safety of new insecticide being used in WA apple orchards. This is a valuable tool for growers and orchard managers to use when explaining the characteristics of new insecticides they are using and why farm workers can reenter an orchard to work after such a short period of time compared to older products.

We had as an objective of the *current project* to complete **case history studies** with which to characterize how different IPM programs implemented a transition strategy and how well they worked. We collected three years of IPM data from seven apple orchards as part of the case history component of the project. These data have been analyzed in

different ways and a report is in preparation and will be placed on the AIPMTP web site, a brief summary of results are given here. The case histories provided a cross section of IPM programs from those that would be considered successful, stable, and cost effective verses those that were not stable and expensive. One way to assess case histories is to examine the cost of different pesticide groups over time. Figure 3 shows the accumulated cost of different pesticide groups over three years, 2007-2009,

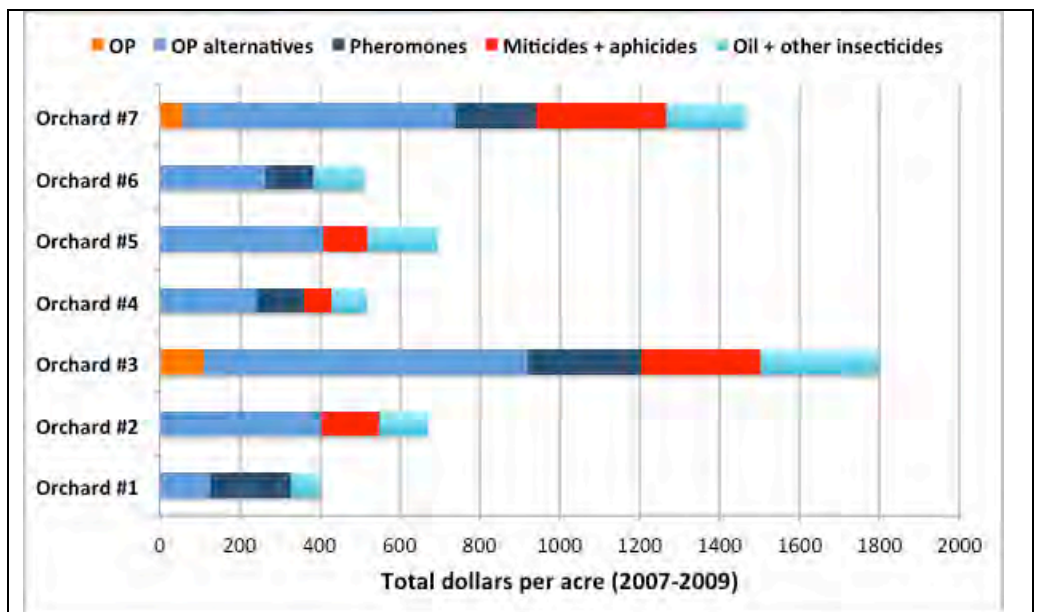


Fig. 3. Accumulated cost (2007-2009) of different groups of pesticides in seven different IPM programs.

in the seven orchards.

The total cost of different IPM programs varied from \$400 per acre (Orchard #1) to \$1,800 per acre (Orchard #3). Note that five of the seven orchard used mating disruption yet three of these were disrupted as noted by the need to apply controls for aphids and spider mites (red bars). It is also noteworthy that even though all the IPM programs used OP-alternatives some of them were more expensive and less stable than others. Our analysis of the cause of instability, that is, the need to apply controls for aphids and spider mites, rested with the choices of OP-alternatives used. We have learned from another study that certain OP-alternatives can increase the risk of disruption of beneficial insects, predators and parasites, which often provide control of aphids and spider mites in apple orchards.

Growers and crop consultants were aware of the risk of increased problems with other pests due the use of OP-alternatives (Table 1). While most of their concerns were tied to reduced efficacy of OP-alternatives or their narrow spectrum of activity, the reality is that certain OP-alternatives do disrupt biological control in apple orchards and this increases the cost of IPM programs. In the case history examples the added cost of disrupting biological control was about 20% of the total cost of the IPM program. These case histories will provide valuable real-life examples of how best to implement OP-alternatives in apple IPM programs.

Describe the significant contributions and roles of project partners. This project's partners were those growers and crop consultants who participated in IUs. They were key in providing feedback on educational programs and resources developed as part of the project and that leave a legacy for all other WA apple growers. We also partnered with Columbia Valley Community Health for outreach activities to farm workers and to develop the pesticide safety poster. Without this partnership it would have been difficult to interface with the farm worker community in an atmosphere where there was trust and respect.

Problems or Delays

There have been some delays in translating some of the eNewsletters into Spanish because the bilingual person on the project was out on maternity leave. This person is now back, working on a different project and will complete the translation of the eNewsletters as soon as possible.

We had also planned on publishing a field guide on pests. This part of the project was delayed while we worked on the on-line training document. We have collected all the necessary elements to complete this aspect of the field guide, however, it has not been published to date and plans are to publish it on-line and not as a hard copy document.

Future Project Plans

This is the last year for this project and culminates four years of educational activities to help transition the WA apple industry to use of new pest control technologies.

Funding Expended to Date

All project funds have been expended for the purposes outlined in the project proposal. No additional funds will be requested and no additional funds were generated by the project.