

WSDA
SPECIALTY CROP BLOCK GRANT PROGRAM
2009
FINAL PERFORMANCE REPORTS

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WSDA Farm-to-School Program

Farm-to-School: Building New Markets for Specialty Crops in Schools

PROJECT SUMMARY

Farm-to-School: Building New Markets for Specialty Crops in Schools was designed to support connections and market opportunities between Washington specialty crop producers and Washington school and institutional meal providers. Market access is critical for fruit and vegetable producers, particularly for the majority of Washington farms that are small and medium scale producers seeking to sell their products— which has become challenging as many market outlets have become consolidated. Demand for fruits, vegetables and legumes have increased in schools and institutions as nutrition has been emphasized in school meal programs and local, seasonal foods and educational connections to the farms that grow them have been shown to increase student consumption of fruits and vegetables. This demand has increased even more over the duration of the grant period, as new federal nutrition standards for schools were released as a result of the 2011 Healthy Hunger-Free Kids Act, requiring increased servings of fruits and vegetables in school meals. While demand is high and interest to sell is great, there are key challenges for specialty crop producers to access this market and schools to access the local products they seek to purchase.

This grant project successfully sought to create more awareness about the market opportunity in Farm to School, address known challenges to succeeding in this market, and conduct surveys of producers, processors and buyers to better understand the farm to institutional marketplace going into the future. The project was based on the following key challenges and opportunities to better serve specialty crop producers in relation to school markets. These were identified through WSDA's work with growers and institutional buyers prior to the grant, and include:

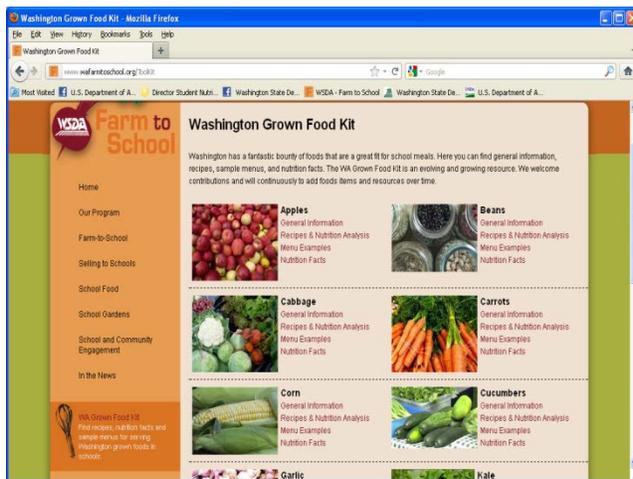
- Informing specialty crop producers about market opportunity, requirements for selling to schools, and how to meet the requirements. Few farmers are aware of the purchasing procedures for schools and how they can develop these sales relationships. Topics for trainings include: networking with schools; local, state and federal policies affecting school food, food safety planning and Good Agricultural Practices, product liability insurance, distribution, food processing, and promotional materials.
- Informing school and institutional food buyers about opportunities and processes for purchasing Washington grown specialty crops. Purchases by these buyers are most commonly done through large food service distributors and government commodity programs. Trainings for food buyers include purchasing from farms or small distributors, seasonal produce availability, menu development, and fresh food handling.
- Basic food processing – School buyers often require fresh product to arrive in minimally processed forms due to labor, equipment or facility constraints. Many farmers have limited knowledge of or access to food processing facilities to provide schools products in the final form that they need, limiting farmer opportunity to sell product. Schools and farms will be surveyed to better understand their processing needs, and food processing companies will be surveyed for WSDA to gain a greater awareness of processing capacity, accessibility and resources needed to increase market connections.

PROJECT APPROACH

WSDA addressed the challenges and opportunities through these activities and tasks.

WSDA Farm-to-School Toolkit

In April, 2011, WSDA launched the Washington Grown Food Kit as the centerpiece to the WSDA Farm to School Toolkit website www.wafarmtoschool.org. This web-based farm to school toolkit for food service workers, farmers, school staff and community members is designed to provide resources to help people meet their farm to school goals. It has a section for each of the audiences with step-by-step guides to getting started with Farm to School, models for supply-chain logistics, information on food safety and liability, and information on education connections and funding opportunities. The toolkit has received 11,397 visits; 8,368 visitors; and 36,755 page views since the site launched in 2011.



The featured item of the toolkit is a Washington Grown Food Kit highlighting school meal recipes and nutrition facts specific to Washington grown specialty crops. Information in this section can be viewed and filtered in multiple ways, enabling searching by crops in season, recipes specific to each crop, and what a full menu would like with each crop being featured. The Washington Grown Food Kit component was modeled after the University of Minnesota Farm to School website. A back-end system administrative tool was included in the development of the website to make edits and additions to the toolkit quick and easy. The toolkit serves as a platform to share resources and deliverables for other Farm to School projects, including a recently-added Farm to School Start-up Kit and “A School’s Guide to Purchasing Washington-Grown Food,” a procurement primer on geographic preference.

Farmer and Food Service Trainings

WSDA created a mobile tour structure to provide an opportunity for farms and schools to see each other in action and learn about the realities of operations on farms and in school kitchens. Bus travel time allows for interaction among participants and encourages potential cooperation to develop supply chain solutions specific to their region. Participants start by visiting two farms that use diverse production methods to grow a variety of crops, and sharing an on-farm meal made with farm-fresh produce, and then travel to a local School District’s central kitchen.





At the school district site, farmers and nutrition staff divide into two break-out groups: one for farmers, focused on market access and development; and the other for nutrition staff to attend a hands-on, peer-led cooking training and prepare 4-6 recipes that comply with USDA standards for school lunch menu planning and feature farm-fresh Washington-grown produce.

WSDA conducted four mobile tours throughout the state:

- Central WA – May 18, 2011
- Spokane – June 13, 2011
- Snohomish County – October 14, 2011
- Olympic Peninsula – October 19, 2011

This project proposed to conduct 3 farmer and 3 foodservice workshops to provide information on institutional markets and how to purchase and prepare Washington specialty crops. In addition to the 4 mobile tours that reached both of these groups, WSDA provided the workshops and presentations listed below.

Additional School Specific Trainings:

- *How to use the WSDA Farm-to-School Toolkit to incorporate WA specialty crops into school meal programs* – Washington School Nutrition Association (WSNA) Conference, Vancouver, WA. July 25th, 2011
- *Washington Grown foods for Taste Washington Day* – WSNA Conference, Vancouver, WA. July , 25, 2011
- *How to utilize WA grown specialty crops in the Fresh Fruit and Vegetable Program* – Fresh Fruit and Vegetable Training, Office of the Superintendent of Public Instruction, Wenatchee, WA. August 17th, 2011
- *How to utilize WA grown specialty crops in school meals and meet the nutrition guidelines for Healthier US Schools Challenge (HUSSC)* – HUSSC Training, Office of the Superintendent of Public Instruction, Everett, WA. September 21st, 2011

Additional Farm Specific Trainings:

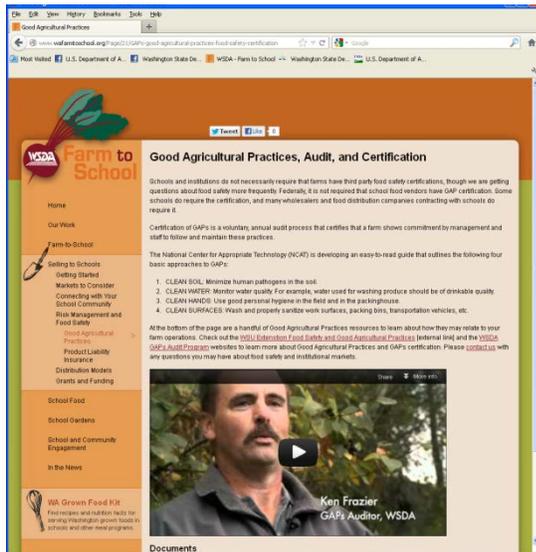
- *Increasing Access Points for Local Products* – South Sound Farm-to-Table Trade Meeting, Olympia, WA. April 11th, 2011
- *Farm-to-Cafeteria: Overcoming Roadblocks, Expanding Opportunities* – Tilth Producers of Washington Annual Conference, Yakima, WA. Sept 13th, 2011
- *Your Farm Feeding Washington's Kids: How to Sell Your Products to Schools* – Washington Sustainable Food & Farming Network Fresh Food in Schools Summit, Olympia, WA. March 8th, 2012
- Outreach to Agricultural Education and WSU Extension Agents on Farm to School, WSU & WSDA Small Farms Team Annual Meetings: April 5th, 2010; March 29th, 2011; and Feb 28th, 2012.

Tradeshows:

- *Regional Bounty Row* – WSNA Conference, Vancouver, WA. August 25th, 2011 – 13 vendors participated
- *Farm to School Showcase* – WSNA Conference, Spokane, WA. July 31st, 2012 – 18 vendors participated

The Annual WSNA Conference includes a tradeshow of over 600 food vendors. WSDA, in partnership with EcoTrust and FoodHub of Oregon, worked to create a Farm to School focused area of the tradeshow to highlight Washington and regional specialty crops and products that are a good fit for school meals. Survey responses from showcase participants are included in the 'Goals and Outcomes Achieved' section below.

Food Safety and Good Agricultural Practices Trainings and Video



Good Agricultural Practices (GAPs) are a voluntary set of food-safety guidelines designed to help farmers handle food safety from the farm to the market. These practices include: developing a food safety plan for the farm; training farm employees about this plan and farm food safety practices; and documenting farm practices to reduce the risk of microbial food safety hazards on farm products.

Schools and other institutional buyers are increasingly asking questions about regulations, food safety and liability as they consider local sourcing of food products. Farmers, especially those operating smaller and diverse farms, have expressed anxiety about the complexity and expense of food safety certification. With this grant, WSDA provided outreach and education of food safety planning and GAPs to farms and agricultural educators.

WSDA conducted two on-farm trainings in partnership with the WSU Small Farms Team and Tilth Producers of

Washington. Participants walked through the farms as host farmers discussed their food safety planning and GAP auditors shared assessment practices. Based on the walk through with the GAPs check list in hand, the groups discussed possible first steps to take and things to consider. Participants were able to view practices that are already in place, and start thinking of what practices make sense to integrate based on individual farms' practices. Events took place on July 26th, 2010 at the WSU Field Station in Puyallup, and on Oct 10, 2011 at Cedarville Farm in Bellingham.

WSDA created a video on Good Agricultural Practices to broaden the reach of GAPs training and information. The video features, farmers, auditors and food buyers addressing food safety and Good Agricultural Practice. The video has received 761 views, and is used by agricultural educations in workshops and classes on food safety. The video is featured on the [WSDA Bridging the Gaps page](#), the [WSDA Farm to School Toolkit](#), and the [WSDA Youtube page](#), and has been used in trainings for WSDA GAP/GHP auditors as part of a current Specialty Crop Block Grant, *Bridging the GAPs*.

Surveys – Farms, schools, food processors

WSDA conducted statewide surveys of farms, schools and food processing companies to gather data on current Farm to School participation, capacity for future participation, and to identify WSDA resources and services that will be most useful to these groups for meeting their Farm to School goals. Specifically, surveys covered production and use of specialty crops, equipment and facilities, vendor requirements, and perceived challenges and benefits of Farm to School. Data from the farm and school surveys was used to evaluate this project

WSU/WSDA Small Farms Team Annual Meetings

Over the course of this grant, WSDA and the WSU Small Farms Team coordinated annual Small Farms Team Meetings of agricultural educators throughout the state. At these meetings, the team worked together to plan, develop and implement training and outreach to small farms and minority and socially disadvantaged farmers on food safety, Good Agricultural Practices and Farm to School. This effort

created broader outreach on these topics, and resulted in partnership with WSU Small Farms Team on the GAPs farm walks and video projects.

GOALS AND OUTCOMES ACHIEVED

Growth in Farm to School during the duration of this grant period was significant. Grant activities included a great deal of outreach and education – informing constituents about Farm to School, seeking feedback from school and farm communities about resources needed, and responded to those needs through in-person trainings and web-accessible resources. This chart shows responses from WSDA 2012 school survey regarding when Farm to School activities in the school district began. The rate of schools beginning farm to school activities rose steadily from 2008 through 2011. In 2008, the Washington legislature passed the Local Farms – Healthy Kids Act, creating the Farm to School Program at WSDA and this SCBG was secured within the first year to complement the program goals. In 2011, funding was eliminated for the Farm to School Program. WSDA support of farm to school and other farm to institution markets continues on a limited basis with grant funds.

Expected Measurable Outcome: Increase the awareness and capacity of farmers and school food service managers of the opportunities to sell/purchase local fruit and vegetables.

Target: 100 farmers will have increased awareness of the opportunity to sell to schools and knowledge of requirements and procedures to do so.

115 farmers attended Farm to School mobile tours and workshops with this grant (40 at mobile tours, 30 at Farm-to-Table Trade meeting, 30 at Tilth Conference, 15 at Fresh Food in Schools Summit). Note, some participants attended multiple trainings. Additionally, combined total of over 60 farmers attended the on-farm GAPs workshops.

Target: 100 school food service managers will have increased awareness and skills to buy local fruits and vegetables.

170 school food service managers and staff attended Farm to School mobile tours and workshops with this grant (60 at mobile tours, 50 at FFVP, 30 at HUSSC, 30 at WSNA). Note: some participants attended multiple trainings. The tradeshow events at the WSNA conferences had a reach of an average of 500 school food service managers and staff.

Increased awareness and capacity were measured through surveys of participants from events, which yielded positive response. The surveys were tailored for each mobile tour and some additional events. The statements below are some examples of survey results:

- One hundred percent of participants from the Spokane tour said their understanding of Farm to School programming improved or significantly improved.
- Eighty percent reported they ‘feel confident they can implement what they learned’ about how to prepare new recipes featuring WA grow food.
- From the Olympic Peninsula tour, 83% responded that the training improved understanding of how to sell to schools and institutions/buy from local farms, and 79% responded that they gained knowledge about food safety practices and 3rd party certifications.
- For the Farm to School Showcase at the WSNA Conference, 63% of participants report making between 6 – 10 significant new connections with school nutrition staff as a result of the Farm to School Showcase.
- When asked ‘Would you like to see the Farm to School Showcase return to WSNA next year?’ 100% of respondents responded: “Yes, absolutely.” Below are quotes from participants:
 - “I loved learning what the school nutrition staff’s needs were. The time spent at the Showcase was highly beneficial to gain insight on how we can meet those needs!” – Bella Terra Gardens
 - “It was fantastic to meet so many wonderful people interested in our locally-grown legumes. It was also great to learn about their [school nutrition staff’s] concerns

regarding the new nutrition guidelines, so we can serve as a resource for them.” – Davidson Commodities

Expected Measureable Outcome: Increase the number of specialty crop growers obtaining GAP certification, and therefore eligible to sell to more markets, including schools.

Target: Fifty new farms will be GAP/GHP certified by 2012.

A combined total of 60 farmers attended the on-farm GAPs workshops. The GAPs video project has received over 760 views, and is used by agricultural educators in workshops and trainings, broadening the reach of the content to wider specialty crop producer and food buyer audiences.

The WSDA 2012 Farmer survey conducted as part of this grant revealed the following information about food safety and Good Agricultural Practices on farms in Washington: The majority of farms who responded to the survey are implementing good agricultural practices, though only 13% have GAP certification. Forty-five percent receive questions about food safety, and many farms are communicating their practices to customers.

Good Agricultural Practices	# of farms	% of farms
I communicate my food safety practices to my customers	114	77%
I implement GAPs in my farm operation	88	61%
I receive questions about food safety safety from my customers	62	45%
I have attended a GAPs workshop/training	58	40%
I document the implementation of GAPs in my farm	39	29%
My farm is GAPs certified	16	13%

All of the above numbers shown from the 2012 survey are up from the 2011 WSDA farmer survey. In 2011, 7 respondents attended a training event, 24 implemented GAPs in their farm operation, and 6 were GAP certified.

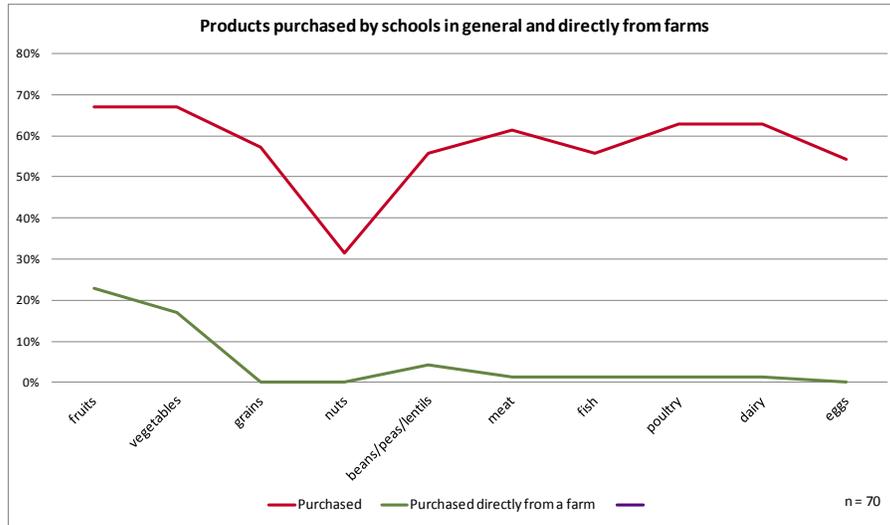
Expected Measurable Outcome: Increase the number of schools buying direct from specialty crop growers.

Target: Ten percent of school districts (30 districts) will be purchasing Washington grown fruits and vegetables by 2012

The 2011 WSDA school survey conducted showed that 49 districts were serving Washington grown foods and 35 districts purchased directly from farms. In the 2012 survey, 47 districts report buying Washington grown and 29 school districts purchasing Washington grown products directly from farms. While the numbers in 2012 are lower than 2011, the total number of responses to the survey was lower, though the percentage of respondents buying directly from farms was same 56%.

Additional related data from the 2012 survey:

- 93% of schools that have purchased directly from farms report that they would do it again.
- Of schools that report purchasing Washington grown foods, 62% responded that they purchase some or all directly from farms and 100% of them purchased some or all of that food through a distributor.
- 81% of schools that have not purchased directly from a farm report being ‘somewhat’ or ‘very’ interested in doing so.



This chart shows products schools purchase in general, and the products they purchase directly from farms. Specialty crops – fruits, vegetables and beans/peas/lentils – are the products schools most commonly purchase directly from farms.

BENEFICIARIES

Beneficiaries of this project include Washington specialty crop producers and school nutrition staff through increasing their knowledge about farm to school, making connections and ultimately increasing sales. Students in Washington schools are getting access to more fresh, Washington grown foods and learning about where their food comes from.

In the 2012 surveys, farms and schools identified the following benefits of farm to school:

Farms most commonly identified the benefits of selling to schools to be:

- Positively impacting children’s health and nutrition
- Raising public awareness about food and farming
- Strengthening community relationships.

Schools most commonly identified the benefits of engaging in Farm to School to be:

- School meal programs supporting the local economy
- Schools buying locally results in good community relations
- High quality fresh product.

Producers and school food buyers gained significant knowledge about farm to school opportunities and logistics from grant programming. Farmers and schools received direct introductions with one another and began establishing the foundation for sales relationships. Going forward, farms and schools want to continue to grow their connections and sales opportunities. In the 2012 WSDA farm survey, 70% of farms ‘would consider’ or ‘are interested’ in growing crops specifically to meet school needs. Of the 22 farms that have sold to schools in the past year, 91% are interested in working with schools to grow specific crops to meet school needs.

Ninety percent of farms who have sold to schools report selling less than \$5,000 worth of products. Sales per farm ranged from under \$500 to over \$1,500,000. Interest to sell to schools is high.

Sales to schools	# of farms	% of farms
\$1 - \$499	8	42%
\$500 - \$1,499	6	32%
\$1,500 - \$4,999	3	16%
\$5,000 - \$24,999	1	5%
\$25,000 - \$99,999	0	0
\$100,000 - \$1,499,999	0	0
\$1,500,000 or more	1	5%



The majority of schools rate the experience of purchasing directly from farms to be positive or 'very positive'. Of schools that have not purchased directly from farms 81% of them are interested in doing so.

LESSONS LEARNED

This project benefitted from having numerous training, tradeshow and outreach events in which WSDA had repeated face time with school districts and farms. This enabled more constant educational and course correction opportunities for WSDA project staff and for farms and schools working through farm to school logistics. Farm to School is an emerging and growing market; it will be critical to continue these communication and educational opportunities.

An additional key lesson learned from completing this project is to be mindful of audience schedules for timing training events and surveys. For scheduling training events, and for the surveys in particular, participation rates would have been higher had the surveys occurred at a different time of year. Conducting farmer surveys in the early winter and school surveys in the early spring would likely gain higher response rates than other times of year.

Food Safety

The expected measurable outcome of 50 new farms being GAP certified was not achieved. Of the over 70 farms that attended on-farm trainings and additional 100 farms that participated in either mobile tours or workshops between 2010 and 2012, only 3 farms were certified by 2012. Farmers shared with WSDA that the certification process – including the planning time, integrating practices onto the farm, documentation, and audit - took between 6 months and two years to prepare for. Additionally, many farms expressed concern about food safety and a desire to integrate the best practices, but many were not interested in certification.

Interest in GAPs and food safety education is high. 64% of survey respondents indicated interest in attending an on-farm GAPs training event. 36% considers hosting a training event at their farm and want more information. Additionally, when asked what information or events farms see as critical to supporting their farm to school goals and selling to other markets, 42% of respondents said GAPs and 35% said general food safety.

Feedback from farmers throughout the grant period informed a follow-up WSDA Specialty Crop Block Grant focusing specifically on Good Agricultural Practices for small and medium size farms with diversified crops. This grant project, *Bridging the GAPs*, is featured in the GAPs video piece developed for this grant.

Food processing

The survey of food processing companies was the first of its kind to be conducted throughout the state, and within the national farm to school effort. For this survey, the 1300 WSDA-licensed food processing companies that utilize specialty crops in their processing were encouraged to participate. The survey was disseminated via email to all WSDA licensed food processors that utilize specialty crops, and partners distributed the survey through their networks. (Partner organizations included: Northwest Food

Processors Association, WSU Small Farms Team, and Tilth Producers of Washington). Responses from 373 companies were received, representing a range of scale, processing type, and geographic location. The data points below indicate that there is opportunity to focus future efforts toward assisting processors in working directly with producers and selling products to schools.

- Three of the top five specialty crops used by food processors are also the top minimally processed fruits and vegetable used by schools in 2011.
- 35% of processor operations reported fit within the USDA definition of ‘minimal processing’. This is relevant because when schools purchase foods for school meal and snack programs, they may apply a geographic preference only to whole and minimally processed foods.
- Eighty-four percent of processors have interest to increase sourcing Washington products directly from producers. Trainings and resources on sourcing directly from Washington growers is one of the most commonly desired resources among food processors.
- 17% of processors indicated interest in resources on selling to schools.

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ADDITIONAL INFORMATION

In-kind matching donations for this project totaled \$72,623. In-kind funds from WSDA came from time contributed to the grant by WSDA employees, valuing \$43,623. Time included project supervision, advisement in retreat and project planning (farmer and school surveys, food processing research and surveys, GAPs video project), and participation in related events. Additional in-kind matching donations were provided by the University of Minnesota Farm to School program for the web structure and code for the on-line toolkit, valued at \$25,000 and from Washington State University Extension support and review of the GAPs video project, valued at \$4,000.

Washington State University
Apple Integrated Pest Management (IPM) Transition Project

PROJECT SUMMARY

The importance of this project lies in the value of apple production to Washington's economy. Apple accounts for approximately 70% of the Washington tree fruit industry, which contributes annually over \$6 billion to the state's economy. For Washington's tree fruit growers to remain competitive in the global marketplace, they must produce high quality, pest-free fruit. To meet requirements imposed by domestic and international regulatory actions, apple growers must successfully implement new integrated pest management (IPM) technologies.

The timely nature of this project is due to regulatory actions on insecticides used in apple resulting in the elimination of several products. Since 1996 the U.S. Environmental Protection Agency (EPA) has significantly restricted use of organophosphate (OP) insecticides, the primary pest control technology used in tree fruit production. In 2007, the EPA acted to implement a complete phase-out of azinphosmethyl (AZM, Guthion) by 2012. This insecticide has been the OP most used to control codling moth, which is the most important pest of apple in Washington. In addition, many overseas markets are imposing similar, or even more stringent, regulatory restrictions on commonly used pesticides, including AZM.

WSU research had shown that employing a range of reduced-risk OP-alternative insecticides in an IPM program could protect crops as effectively as older, OP-based, programs. The need for this project lies in the fact that there were a number of significant barriers to the adoption of OP-alternative technologies. The OP-alternatives have lower efficacy, require more precise timing and better spray coverage, have different modes of activity requiring different use patterns, and are more expensive than products they are intended to replace. For Washington apple growers to adopt and manage new OP-alternative technologies, a systematic, extensive, and ongoing education and outreach effort was required.

The Apple IPM Transition Project (AIPMTP) addresses the critical challenges imposed by increased regulatory action restricting or eliminating old pest control technologies by enhancing adoption of new technologies via an industry-wide implementation of biologically intensive IPM. While the AIPMTP was not previously funded by the SCBGP, an earlier project, the Pest Management Transition Project (PMTP), had received funding from the Washington legislature based on the full support of the Washington tree fruit industry. A final report of the PMTP project can be found at <http://pmtip.wsu.edu/>. The AIPMTP project built upon the foundation of educational materials and framework for delivering new IPM knowledge to growers and consultants developed in the PMTP. AIPMTP used baseline information generated by the PMTP to demonstrate changes in IPM practices over time. The AIPMTP built on the established working relationships with the farm worker community to enhance their understanding and support of IPM transitions occurring in the Washington tree fruit industry.

The goals of the AIPMTP were to:

- accelerate the adoption of new IPM technologies through educational programs and communication of research-based knowledge,
- improve real-time pest management decision-making through increased use of the web-based WSU Decision Aid System, and
- document changes in practices, attitudes, and perceptions of growers, IPM consultants, and farm workers.

PROJECT APPROACH

Accelerate the adoption of new IPM technologies through educational programs and communication of research-based knowledge

The AIPMTP delivered new knowledge to the apple industry through Implementation Units, a web site, newsletters, traditional meetings, publications, and the WSU Decision Aid System.

Implementation Units. Implementation Units are groups of growers and consultants who desired to meet together to improve their understanding of how to use new OP-alternative technologies in their apple IPM programs. These groups were small in size, 6 to 25 members, distributed throughout the state, and were comprised of industry leaders and early adopters.

In 2010 WSU met with two new IUs and held several meetings with other IUs during the growing season. It was obvious that the existing IUs had a good understanding of the transition from AZM to new reduced risk technologies associated with control of the codling moth. However, there remained questions on how to deal with secondary pests, especially the woolly apple aphid and in 2010 the rosy apple aphid.

Website. The AIPMTP website is a primary means of delivering information on current issues to clientele as well as preserving archives of historical information. The website developed under the previous project was redesigned and reorganized to improve visitor satisfaction and accessibility. The navigation structure was streamlined to make it easier to find desired content. On the Home page 'Special Interest' links were reduced and reclassified by type: News & Events, Industry Links and IPM Resources for quicker access. New features added to all pages were 'Share' links, which allowed visitors the ability to print, email or to share page content on social media websites such as Facebook and Twitter. An easier 'subscribe' method was included allowing people to be added directly to an automated mailing list to receive newsletters and meeting/event notices. Other additions to the site include publication of all progress reports and all surveys as soon as they are completed. These reports are also made available for downloading as PDFs from the related web page.

Analysis of the site visitor log showed that the most popular pages were the newsletter pages (current and archived issues) to view or download issues (32%), the fruit school page to watch videos (14%), the handbook page to download it by section or in its entirety (10%) and the tours and events page to watch slideshows or download event packets or flyers (8%). Most visitors viewing the site did so by way of: referring links on other sites including industry link pages, DAS, Twitter and Facebook (33%); bookmarks (30%), indicating a desire for repeat viewing; a keyword search (24%); or by using the link contained in the subscriber email notice (12%). Overall, site visits peaked when new newsletters or events were announced via emails, Twitter and Facebook, but a steady stream of visitors found the site via search engines and referring industry links.



Implementation Unit meeting in Quincy, WA.

AIPMTP Handbook. The handbook developed during the previous project was updated and reprinted for use in the AIPMTP educational activities in 2010. References to the old codling moth degree-day model were updated to reflect the model used in the WSU Decision Aid System (DAS). In addition, a thorough explanation of how degree-day models are used in orchard IPM and how they are used in conjunction with DAS was added. Other changes to the handbook include an expanded pest monitoring section, an expanded secondary pest discussion, an updated web references section, and the addition of a natural enemies pictorial guide to the appendices. The updates include some changes in insecticide use recommendations and new information on the impacts of insecticides on natural enemies. A completely updated version of the AIPMTP Handbook is available as a pdf on the projects web site - <http://pmtip.wsu.edu/handbook.html>.

Translation of the AIPMTP Handbook from English to Spanish was completed, published, and disseminated. This tool serves as a great aid to the Spanish-speaking growers in Washington who are very interested in transitioning their IPM programs to new and safer technologies. An example of a page of the Spanish Language Handbook is shown to the right. As with the English version of the handbook, the Spanish version is available as a pdf download from the project website.

Educational Newsletters. Five issues of the project newsletter were produced and disseminated. All newsletters can be viewed online on the project website, where they can also be downloaded for printing (<http://pmtip.wsu.edu/newsletters.html>). Back issues of the newsletter are available to view or download from an archive index page. There are nearly 400 subscribers receiving the newsletter either electronically or by post. A new automated newsletter subscription link was added to the website allowing people to join the electronic mailing list. With the automated electronic subscription WSU can tell not only who receives the newsletter, but also who actually views it online or downloads the pdf version and who forwards the newsletter announcement to others.

Specialized Farm Worker training. IPM presentations were made at two WSU-sponsored pesticide re-certification classes (Pasco and Wenatchee) as well as at the Washington Tilth Organic Producers Association conference, the Washington State Horticultural Association conference, and the GS Long annual meetings to a total of 788 Spanish-speaking pesticide applicators and supervisors (with some growers, managers, and consultants in the mix). During these sessions, questions were asked using the Turning Point audience response system to survey participants on their knowledge of the pesticide transition and pesticide health and safety. Summary results from these surveys are presented under the section on documentation.



Example of a page from the AIPMTP Handbook translated into Spanish.

Final results of the specialized farm worker training surveying participants on their knowledge of the pesticide transition and pesticide health and safety during winter 2009-2010 are posted on our website (http://pmpw.wsu.edu/TPsurvey2010_Sum.html) alongside comparative results from 2008-2009. Results showed that the pest management transition is underway in apple orchards, as IPM tactics and alternative insecticides are becoming more widely available, understood, and used by pest applicators and supervisors as well as growers and consultants.

A pesticide safety poster was designed to help farm workers better understand the differences in human toxicity between organophosphate insecticides and newer alternative insecticides was created, presented, and distributed to 60 farm worker health outreach workers at the Washington Association of Community and Migrant Health Center spring outreach training in April. Participants caught on very quickly as to how to read the poster and how they could use it in their outreach to farm workers. Fifteen of these outreach personnel also agreed to be contacted later in the summer to provide feedback on how useful the poster was (or was not) for communicating health and safety information to migrant and seasonal farm workers during the 2010 season. The poster was also distributed to growers and managers for display at orchard workplaces, and is posted online for easy downloading

(http://pmpw.wsu.edu/Ref_tools.html).

Finally, the poster was presented and distributed to farm workers at health fairs at worker housing camps in Monitor and Malaga through the playing of a pesticide safety roulette game designed to teach participants how to read and interpret the poster. These health fairs were sponsored by the Washington Association of Community and Migrant Health Centers, Columbia Valley Community Health, and AIPMTP, and attended by about 425 people total (275 in Monitor, 150 in Malaga).

AIPMTP also participated this quarter in a research review of the University of Washington's Pacific Northwest Agricultural Safety and Health Center to identify research priorities in worker health and safety for the coming years.

Presentations on AIPMTP were given at the Department of Pesticide Safety Registration tour in Prosser in July and the Washington State Association of Public Health professionals conference in Yakima in October. In addition, the pesticide safety poster was presented and distributed to farm workers and community

NO SIGNAL WORDS - SIN PALABRAS CLAVE (LOW RISK - RIESGO BAJO)	CAUTION - PRECAUCIÓN	WARNING - AVISO	DANGER POISON - PELIGRO VENENOSO
Altacor	Actara	Calypso	Carzol
Success	ADMIRE	DANTOL	Guthion
	Apollo	Diazinon	SUPRADE
	ASSAIL	OMETHATE	Thionex
	Avaunt	Imidan	Vendex
	BELT	Lorsban	
	BT	NEXTER	
	CYD-X	Rimon	
	Delegate	SEVIN	
	Entrust		
	Esteem		
	Intrepid		
	PETROLEUM OIL		
	Proclaim		
	Provado		

Pesticide safety poster showing relative risk of different insecticides commonly used in apple orchards.



Organizers of Health Fairs in Monitor and Malaga, WA, 2010.

members at the Quincy Community Health Clinic back-to-school health fair in August.

Improved real-time pest management decision-making through increased use of the web-based WSU Decision Aid System

WSU Decision Aid System. Dr. Ute Chambers served as Manager of the WSU-DAS in 2010. She worked with the AIPMTP team to integrate educational and outreach activities of WSU-DAS where her background in IPM research and implementation was very valuable. She participated in the Implementation Unit meetings to review the new features of WSU-DAS and interacted with consultants and growers on their needs for IPM education.

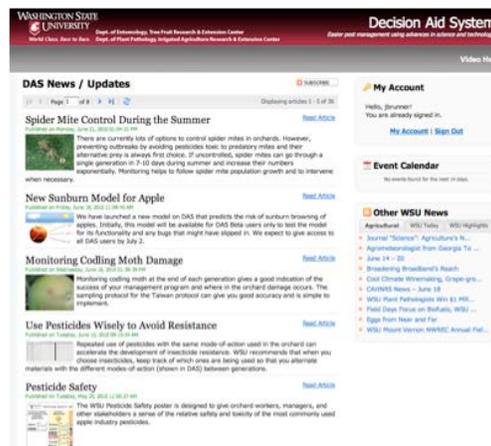
The online video tutorials and online DAS Manual were completed and implemented in the WSU-DAS Help Center. Both help features assist old and new users in accessing and using the system to its capacity. The WUS DAS monitoring system shows that the video tutorials have been viewed frequently (393 times in total). The most viewed tutorials are “Set Up a New Weather Station” (121 times) and “View Model Options” (82 times).

The re-designed front page of DAS now highlights seasonal-specific issues growers need to be concerned with. These stories are regularly updated and cover a wide range of information from insect control tactics to spray drift to bee pollination. Many of these posts are based on work done in the AIPMTP and include links to the AIPMTP homepage and newsletters, as well as other IPM related websites of WSU. To date, 36 stories have been posted on the DAS front page. The number of views per story ranges from 21 to 295 (total 3319). The most read stories are “DAS is now on the iPhone” (295 views), “DAS workshops” (246 views), “New codling moth degree-day/development table” (218 views), and “Leafroller and codling moth movement during the season” (210 views). The first two stories have been published the longest.

An online survey of 2010 registered users was conducted. The results of this survey have been compiled and are presented in the documentation section.

An iPhone compatible web format of WSU-DAS was launched in February 2010, which allows users to access DAS from anywhere in cell phone reception range. Users can view current and projected pest conditions and management recommendations as well as the Mini WSU Spray Guide.

All pest conditions and management recommendations on WSU-DAS have been translated into Spanish. Various options are being considered how to translate everything else on the website, including links, buttons, table headings, etc. Google Translate is being tested as one of the options. The Spanish WSU-DAS was opened up in May 2010 for our beta-testing group, which includes several native speakers, to evaluate the Spanish language part of the system.



DAS front page showing examples of seasonal-specific issues of interest to growers.

DAS has been reformatted to optimize it for search engines, i.e. to make certain pages and the RSS feed more search engine friendly. As a result, Google has been indexing far more information in the last two weeks than in the past (number of pages crawled per day). Over time, this improves search engine placement and will make the WSU-DAS website more easily available to the average web user. Additionally, all video tutorials for DAS have been published on YouTube.com to increase DAS' Internet visibility.

WSU are in the process of planning and designing new filters for the DAS pesticide database (WSU Spray Guide). These filters will allow users to search for pesticides that specifically have a low or no negative impact on certain natural enemies with the goal to enhance biological control. Also, the new filters will assist users with resistance management by enabling the user to search for pesticides with a resistance class (mode of action) that is different from previously applied products.

Outreach. During the winter 2009/2010, talks on the WSU-Decision Aid System were presented at six industry sponsored grower meetings (North Central Washington Apple Day, Wenatchee; North Central Washington Stone Fruit Day, Wenatchee; Okanogan County Horticulture Society Meeting, Okanogan; Northwest Wholesale, Brewster; Chelan Fruit Growers Day, Okanogan; and Wilbur Ellis, Tonasket), as well as at the GRAS2P Orchard Sustainability Workshop, the Western Orchard Pest and Disease Management Conference (Portland, OR), the WSU Pesticide Education Program (Wenatchee), and the International Cherry Growers Tour (Wenatchee). In addition, updates on the Decision Aid System were presented at three Spanish language pesticide recertification classes (Wilbur Ellis, GS Long, and WSU Chelan County Extension), as well as through poster presentations at the Washington State Horticultural Association conference in Wenatchee and the annual meeting of the Pacific Branch Entomological Society of America in Boise, ID. Also, updates on DAS were featured in the March 2010 issue of the magazine Good Fruit Grower.

A mailing campaign (emails as well as postcards) was launched in January 2010 to AIPMTP IU members to advertise DAS training workshops this season. Additionally, DAS training workshops are continuously advertised on the DAS home page. Between February and June 2010, 12 workshops (20 hours in total) were held on request in small groups (3-9 people) or individually. A total of 51 participants were walked step-by-step through all features available on DAS. All participants could experience DAS hands-on for themselves at their own laptops or with notebooks provided from the DAS-AIPMTP mobile computer lab. Two workshops were held for Hispanic growers, who had not used the system before, demonstrating the features of DAS, including the Spanish web sites. Further mailing campaigns are planned in January 2011.

Workshop participants were asked to fill out an evaluation questionnaire at the end of each workshop to assess if the participants increased their knowledge on how to use DAS and where the training sessions can be improved. The overall assessment of the workshops was very positive, and all participants learned new ways to use DAS for their operation. Several suggestions were offered on how to improve future training. The workshops also gave valuable insight in how people use DAS, what features they use and do not use. For example, the filter options in the WSU spray guide and the historic weather data center have not been widely used. Such observations allow us to tailor our educational efforts more effectively and to improve the DAS interface to be more intuitive and self-explanatory.

Document changes in practices, attitudes, and perceptions of growers, IPM consultants, and farm workers

Implementation Unit Survey. At the beginning of this project, in the fall of 2009, WSU used the Turning Point audience response system to assess learning and knowledge of alternative insecticides and IPM practices, and to gather feedback to improve Implementation Units for 2010. Evaluation results showed that most participants in Implementation Units were grower/managers (62%) or warehouse fieldmen (23%), 85% of whom made or contributed to apple pest management decisions. Fifty-two percent used or recommended AZM, a much lower percentage than the industry-wide 93% of consultants

and 80% of growers who used or recommended AZM in 2007 and 2008, respectively. Among Implementation Unit members, 81% used or recommended alternatives to AZM, especially Delegate (81%), Assail (71%), Altacor (67%), and Intrepid (65%), and 85% used or recommended codling moth mating disruption, again both values higher than industry-wide percentages.

Most Implementation Unit members (79%) reported that codling moth did not cause unacceptable damage in their apple orchards in 2009. Some expressed concern about leafroller (37%) and woolly apple aphid (27%). Most (65%) had used the WSU Decision Aid System (DAS) in 2009 to help time IPM activities, and 89% indicated an interest in learning more about DAS. Of those interested in learning, 48% preferred instruction in small group hands-on workshops, 21% preferred using video tutorials and the DAS manual online, and 17% preferred individual lessons with WSU Extension educators. These results showed us that Implementation Unit members had experienced success in transitioning their IPM programs to use of OP-alternatives and provided guidance on educational needs for Implementation Unit meetings for 2010, especially DAS education opportunities. For more results see the AIPMTP web site (http://pmtip.wsu.edu/survey_IUres1.html).

Apple Consultant Survey. The AIPMTP conducted a consultant survey in January of 2010. With the completion of this survey it is now possible to compare consultants' insecticide recommendations, knowledge of IPM tactics, and thoughts about the AZM phase-out with results from a similar survey conducted in 2007 to see how these recommendations, tactics, and thoughts have changed during the course of the AZM phase-out. While some of results remained the same between 2007 and 2009, other aspects changed. Highlights of these changes are as follows:

In 2009, consultants perceived less damage from insect pests in apple orchards overall. Eighty-one percent (81%) felt that codling moth had caused unacceptable crop damage, down from 98% in 2007. Similarly, 47% felt that woolly apple aphid had caused damage compared to 70% in 2007, and 26% felt that spider mites had caused damage compared to 55% in 2007.

In 2009, 18% of consultants felt that codling moth caused unacceptable damage every year, down from 67% of consultants in 2007. In 2009, fewer consultants (15%) felt codling moth injury had increased over the previous three years compared to 2007 (40%), and more consultants (68%) felt that injury had remained steady compared to 2007 (48%). Thus, the concern of strong and rising codling moth damage seemed to have decreased over this two year period.

Organophosphate (OP) recommendations for codling moth decreased between 2007 and 2009. In 2009, 83% of consultants recommended AZM to control codling moth, down from 93% in 2007. And 74% stated in 2009 that their recommendations of OP insecticides for codling moth had decreased over the past three years, up from 35% in 2007.

In 2009, consultants also perceived less leafroller damage, with 16% saying they found acceptable damage 2 out of every 5 years or more, down from 69% in 2007. Accordingly, fewer consultants recommended Lorsban in 2009 (61%) than in 2007 (80%), and a higher percentage did not recommend any OP insecticides for leafroller in 2009 (25%) as compared to 2007 (13%).

In 2009, more consultants (69%) knew that 2012 would be the last year AZM could be used, up from 55% in 2007, and more answered correctly that the phase-out schedule would limit the total amount of AZM that could be used by a grower each year (52%, up from 32% in 2007). Thus, knowledge of the AZM phase-out had increased over time.

In 2009, more consultants felt that there were effective alternatives to AZM (mean score rose by 0.25 on a 1-5 scale), and that the phase-out would protect the health of agricultural workers (mean score rose 0.35) and the environment (mean score rose by 0.3). More consultants also felt that growers would bear the

burden of the AZM phase-out (mean score rose by 0.76), and that the cost and control of leafrollers would be more difficult after the phase-out (mean scores rose by 0.38 and 0.43). Fewer consultants felt in 2009 that control of codling moth would be more difficult (mean score dropped by 0.27) or that tree fruit production would be riskier for growers (mean score dropped by 0.41) after the AZM phase-out.

In 2009, slightly fewer consultants (62%) were interested in additional training on how to use AZM alternatives to manage pests than in 2007 (75%). This might be in part because more had already received training through AIPMTP and other venues.

Overall, it seems as though consultants in 2009 were more knowledgeable about and felt more in control of pest management in a world without (or soon to be without) AZM, and fears of codling moth damage increasing because of the phase-out had declined. Some of these differences between 2007 and 2009 data could be due to a larger sample size used in 2009 (120 of 200 surveys completed in 2009, compared to 40 of 73 in 2007), or perhaps to a greater representation of consultants working in the southern tree fruit regions (15% increase in representation from Yakima and the Tri-Cities in 2009) than in the north (16% decrease in representation from Wenatchee in 2009), but mostly they are likely to be due to consultants' increased experience working with AZM alternatives and with the success of AIPMTP efforts to provide resources for transitioning away from AZM (45% of consultants in 2009 had participated in an AIPMTP Implementation Unit, and 87% knew about the AIPMTP). These results demonstrate significant benefit from AIPMTP outreach to consultants over the past several years.

Farm Worker Survey. Results from the farm worker surveys indicate that most respondents (71%) have worked with AZM and know that it was being phased out (82%). Most have worked with pheromones (77%), know well or somewhat well how to manage crop production without AZM (69%), and know well or somewhat well what IPM is (68%). These results are similar to data gathered in 2008-09. In 2009-10, however, knowledge of the timing of the AZM phase-out was 33% higher than it had been in 2008-09, and the number of respondents who had worked with the OP-alternative insecticides Altacor, Calypso, and Delegate increased by 68%, 38%, and 23%, respectively. Pesticide safety data were fairly consistent between 2008-09 and 2009-10, and indicated that most respondents were aware of important safety measures for working with pesticides, such as personal protective equipment, re-entry intervals, and pesticide label information. In general, results showed that the pest management transition is underway in apple orchards, as IPM tactics and OP-alternative insecticides are becoming more widely available, understood, and used. There is, as always, room for participants to learn more about how to use IPM strategies to manage crops without AZM, and an ever-present need for reinforcement of safety knowledge and standards as the kinds of insecticides used change over time. Results of the 2008-09 and 2009-10 surveys are posted on our website (http://pmtip.wsu.edu/TPsurvey_res1.html).

DAS User Survey 2010. A survey of WSU DAS users was conducted in 2010. A summary of some results are presented below. More details are available in the section *Additional Information*.

- Participants: 154 participants answered the voluntary user survey, 34.4% of active users. 40.3% of the survey participants started using DAS within the last 2 years.
- User occupation: The majority of the survey participants are growers/orchardists (60.8%), 37.9% are orchard managers, 20.2% work as Ag Chem distributor consultants, 16.3% are Packinghouse/ Company fieldmen, 13.7% work in research and/or extension, 9.8% work as private crop consultants, and 9.1% have other occupations.
- How easy is DAS to use: Most users rated the use of various features of DAS as easy or very easy. The average rating on a scale from 1 (= very easy) to 5 (= impossible without help) for first time registration, setting up a user profile, editing the user profile, viewing model results, viewing model charts was 1.8, 1.9, 1.9, 1.6, 1.7, respectively.

- Impact of DAS: The majority of survey participants (56.0%) indicated an increase in the level of pest control due to the use of DAS; 29.0% saw no change and 7.0% reported a decrease in pest control level (8.0% answered “not applicable”).
- WSU also asked how the user’s operation would be affected if DAS was discontinued next year. The majority of survey participants indicated that the discontinuation of DAS would have major or modest impacts on the user’s number of sprays (21.4% “major”, 49.0% “modest”, 29.6% “no impact”).
- DAS support: Almost half of the survey participants (45.6%) have requested any kind of support from the DAS team and rated the responsiveness, helpfulness, and friendliness good or excellent (100%, 95.2%, and 100%, respectively).
- Models used in DAS: The most used models on DAS are codling moth (93.0%), fireblight (79.7%), western cherry fruit fly (65.0%), oblique-banded leafroller (63.6%), cherry powdery mildew (58.7%), and Pandemis leafroller (54.5%). For 62.2% of the survey participants, the codling moth model was the most important model, while for 21.5% fireblight and for 5.2% western cherry fruit fly is the most important model.

GOALS AND OUTCOMES ACHIEVED

The primary goal of the AIPMTP was to accelerate the adoption of OP-alternative insecticides by 20% while reducing the recommendation of OP insecticides by 20%. Based on the various survey results, these targets were met. The Experiences shared by IU participants and others in the apple industry indicate that the transition has been achieved without major disruptions of pest control programs. IU participants indicated that after two years of participation in the PMTP, a predecessor project to AIPMTP, that the use or recommendation of AZM (59%) was lower than that reflected in the consultant survey (67%). Eighty-four percent (84%) of IU participants either used or recommended the use of OP-alternatives for codling moth control and 65% used pheromone mating disruption. Funding of the AIPMTP allowed WSU to continue working with the IU participants after the funding for the PMTP had ended, therefore results shared above are attributable to this project and reported on the AIPMTP web site (http://pmtp.wsu.edu/survey_Cres1.html).

Surveys for consultants showed changes from 2007 to 2009, which represents a growing season prior to and one two years after the PMTP had been functioning (see Apple Consultant Survey). Highlights of changes between 2007 and 2009 include: a 31% drop in the concerns over unacceptable crop damage by codling moth, a 23% drop in concerns about woolly apple aphid, a 29% drop in concern about spider mites, a 10% reduction in recommendations to use AZM, a 39% decrease in the recommendations of OP insecticides, a 29% reduction in the recommendation to use Lorsban for leafroller control and a 14% increase in the number of consultants that knew the last year AZM could be used (Table 1). Without the AIPMTP the 2009 consultant survey could not have been conducted so results of this activity are attributable to it.

Table 1. Percent consultants responding to statements about pest control recommendations, 2007 vs 2009.

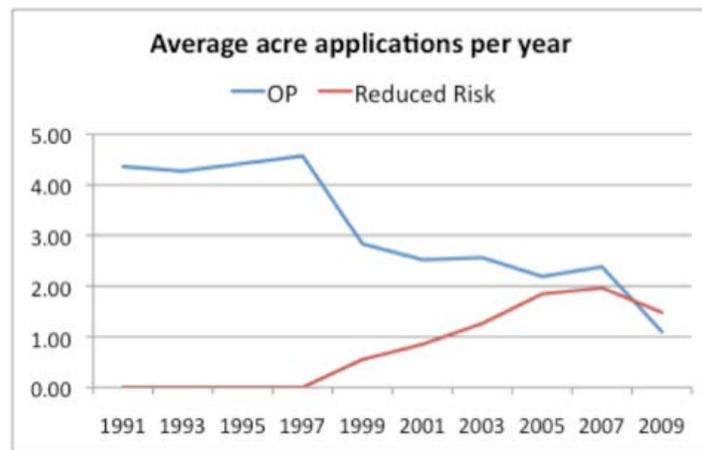
Statement	2007 survey results	2009 survey results
Codling moth caused unacceptable crop damage	98%	67%
Woolly apple aphid caused unacceptable crop damage	70%	47%
Spider mites caused unacceptable crop damage	55%	26%
Recommended use of AZM	93%	83%
Recommendations of OP insecticides had decreased	35%	74%
Recommended use of Lorsban for leafroller control	80%	61%
Knew that the last year of AZM use was 2012	55%	69%

The 2008 apple grower survey served as a baseline for the grower survey that will take place under the continuation of the AIPMTP through approval of an addition year of SCBGP funding, (FY11). By comparing the 2008 to the 2010 grower survey, WSU will be able to document the contribution of the SCBGP funded programs in changing practices and attitudes.

The National Agricultural Statistics Service (NASS) Pesticide Use Survey has been conducted on odd numbered years from 1991 through 2009 and provides a clear picture of changes in pesticide use over time. The figure to the right shows changes in acre applications (percent acres treated time the average number of applications) of OP insecticides and reduced risk (OP-alternative) insecticides from 1991 through 2009. The decline in the acre applications for OPs in 1999 was due to regulatory action against these products and to the adoption of pheromone mating disruption for codling moth by the apple growers of Washington. The decline in acre applications of OP insecticides in 2009 compared to 2007, 55% representing a decline of over 270,000 pounds of OP insecticide, must in large part be attributed to the apple industry adopting reduced risk (OP-alternative) insecticides as mediated by efforts of the AIPMTP. The concurrent reduction in the acre applications of reduced risk (OP-alternative) insecticides in 2009 compared to 2007 suggests that apple growers were becoming more confident and were getting good results with these products.

When comparing the apple grower survey with NASS survey data there are some interesting observations. The 2007 NASS survey indicated 66% of acres used AZM while our 2008 apple grower survey indicated that 80% (of growers) used AZM at least one time. The average number of applications of AZM in our 2008 apple grower survey was 2.4, which is the same as the 2007 NASS survey (2.4), but higher than the 2009 NASS survey of 1.7 applications. Our apple grower survey identifies many more facets of pesticide use than the NASS surveys. For instance, 50% of apple growers in our 2008 survey indicated that they had decreased use of OP insecticides for codling moth in the previous three years while only six percent (6%) said that they had increased OP insecticides use during the same period.

Interestingly nine percent (9%) said that they used no OP insecticides for codling moth control during the previous three years. Sixty-five percent (65%) of Washington apple growers indicated that they used pheromone mating disruption for codling moth control. However, the NASS survey does not pick the use of pheromones because they do not ask a question that growers recognize as being products used for mating disruption.



Acre applications of OP and reduced risk (OP-alternatives) based on NASS Pesticide Use Survey data from 1991-2009.

The second outcome of the project was to increase the use of the WSU Decision Aid System (DAS) by 20%. In reality, the number of users has almost doubled (451 active uses compared to 247 in 2008) as a result of the outreach activities and value of the decision support system. The contribution of the AIPMTP to enhancing and upgrading aspects of the WSU DAS in 2010 provided an easier platform for growers and consultants to use in setting up their personal accounts, learning about the features of DAS, and in accessing information.

The third outcome of the project was to affect a 20% increase in farm-worker knowledge of IPM and reduced-risk insecticides. Results are mixed with certain knowledge remaining similar to the baseline data, while other knowledge grew beyond the 20% target.

Most respondents (71%) have worked with AZM and knew that it was being phased out (82%). Most have worked with pheromones (77%), know well or somewhat well how to manage crop production without AZM (69%), and know well or somewhat well what IPM is (68%). These results are similar to data gathered in 2008-09.

However, knowledge of the timing of the AZM phase-out was 33% higher than it had been in 2008-09, and the number of respondents who had worked with the OP-alternative insecticides Altacor, Calypso, and Delegate increased by 68%, 38%, and 23%, respectively. Pesticide safety data were fairly consistent between 2008-09 and 2009-10, and indicated that most respondents were aware of important safety measures for working with pesticides, such as personal protective equipment, re-entry intervals, and pesticide label information. In general, results showed that the pest management transition is underway in apple orchards, as IPM tactics and OP-alternative insecticides are becoming more widely available, understood, and used. There is, as always, room for participants to learn more about how to use IPM strategies to manage crops without AZM, and an ever-present need for reinforcement of safety knowledge and standards as the kinds of insecticides used change over time. Results of the 2008-09 and 2009-10 surveys are posted on our website (http://pmtip.wsu.edu/TPsurvey_res1.html).

BENEFICIARIES

While this project is not considered truly complete, since one more year of funding has been awarded by the Specialty Crop Block Grant Program, WSU can identify groups and organizations that have benefited as a result of the AIPMTP activity to date.

The primary beneficiaries of the AIPMTP project have been the apple growers and orchard managers of Washington and the consultants that provide IPM advice to them. These groups were the ones most directly impacted by EPA regulations on OP insecticides, especially on the phase-out of AZM. Because WSU had been conducting research for several years on the reduced risk, OP-alternatives that would replace OP insecticides, answers were readily available on the characteristics of these new pest control technologies and how to incorporate them into IPM programs. External funding provided the capacity to deal with barriers to adoption facing the Washington apple industry. The primary activity of the AIPMTP was to educate growers, orchard managers and consultants on the relative efficacy, timing and rates of OP-alternative products targeting codling moth and leafrollers and to inform them about unintended consequences of some OP-alternatives on beneficial insects (predators and parasites). These groups were informed using a variety of methods, which together produced changes in opinions, attitudes and, most importantly, practices. The evidence of changes in attitudes and practices has been documented in various survey results discussed in the documentation section of the chapter on Project Approaches and the chapter on Goals and Outcomes Achieved.

The benefit to growers and orchard managers comes by achieving desired crop protection with minimal pesticide inputs, thus potentially reducing costs, and through efficiencies gained in farm labor management due to short re-entry periods (hours instead of days) of OP-alternatives compared to OP insecticides. The consultants were able to recommend crop protection programs based on sound science and to share their experiences with each other therefore expanding their knowledge base and gaining insights into practical programs that worked in different orchard settings and with growers that had differing risk aversions. Both groups benefited from improvements made in the WSU DAS, which allowed them to precisely time insecticide applications and helped them choose the from a list of products that best fit their crop protection goals.

The farm worker community was another beneficiary of the AIPMTP. Specialized farm workers, those who were employed to manage or apply pesticides to orchards, received training on the new insecticides being used in orchards as well as the phase-out of AZM. Knowledge gained about the relative safety of OP-alternative insecticides helped specialized farm workers understand the short re-entry intervals associated with these products and to gain appreciation that their work environment had become much safer. Temporary farm laborers, those who provided seasonal labor for pruning, fruit thinning, and harvest, also benefited by learning some basic information about the safety of OP-alternative insecticides used in orchards. They also gained directly from a safer workplace environment. While they may not have fully understood the impact that changes apple growers had made in pest control programs, they none the less benefited from reduced risks to their health and the health of their families. Citizens of Washington benefit indirectly because OP-alternative insecticides being implemented into apple IPM programs represent a reduced risk of negative impacts on the environment. Almost all OP-alternatives have low or very low toxicity to wildlife (mammals and birds) and to fish. While some OP-alternatives can have a negative impact on aquatic organisms that fish use for food, and these concerns need to be addressed by appropriate practices, the overall benefit to the environment from transitioning to OP-alternatives in apple IPM programs is substantial.

Regulatory agencies benefit because they have access to real data documenting changes of attitudes and practices of groups affected by their activities.

LESSONS LEARNED

Capacity is required to change attitudes and practices is substantial both in personnel needed and time commitments. Changing attitudes and practices is always a challenge, especially when those changes are dictated by an external authority, e.g. government imposed regulations. The capacity within WSU that made the AIPMTP possible was the research knowledge on OP-alternatives that had been developed over time through external funding. The capacity of people to implement a program that would result in a desired outcome of changed attitudes and practices was not present within WSU and therefore external resources were needed to hire the right people that could implement the educational program that was needed. This capacity included a social scientist, a communications and web specialist, and a project manager.

Dr. Nadine Lehrer was a key member of this project by providing expertise in the area of social science plus her bilingual skills - English and Spanish. She was a key resource for designing and implementing surveys that formed the basis for documenting changes in attitudes and practices. Without her expertise the project would not have achieved its goals in this area.

Partnering with industry leaders, both growers and crop consultants, was key to the success of the project. These individuals represented the early adopters and influencers who spread the information and knowledge they gained to others.

By partnering with key people in the farm worker health networks WSU was able to reach and impact a key beneficiary group that WSU could not otherwise have gained access to. The partnership with these people provided access and credibility to the message WSU delivered to the farm worker community.

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ADDITIONAL INFORMATION

Survey Comparisons – Pest Management Consultant Results - 2007 and 2009

With the completion of the 2009 survey of apple pest management consultants, it is now possible to compare consultants' insecticide recommendations, knowledge of IPM tactics, and thoughts about the AZM phase-out with results from a similar survey conducted in 2007, in order to see how these recommendations, tactics, and thoughts have changed during the course of the AZM phase-out. While some of results remained the same between 2007 and 2009, other aspects changed. Highlights of these changes are as follows:

In 2009, consultants perceived somewhat less damage from insect pests in apple orchards overall. Eighty-one percent (81%) felt that codling moth caused unacceptable crop damage, down from 98% in 2007. Similarly, 47% felt that wooly apple aphid caused damage compared to 70% in 2007, and 26% felt that spider mites caused damage compared to 55% in 2007.

In 2009, 18% of consultants felt that codling moth caused unacceptable damage every single year, down from 67% of consultants in 2007 (instead, most consultants (52%) in 2009 reported unacceptable damage one year or less out of every five). In 2009, fewer consultants (15%) felt codling moth injury had increased over the previous three years compared to 2007 (40%), and more consultants (68%) felt that injury had remained steady compared to 2007 (48%). Thus, the perception of strong and rising codling moth damage seemed to have decreased over this two year period.

Organophosphate (OP) recommendations for codling moth decreased accordingly between 2007 and 2009. In 2009, 83% of consultants recommended AZM to control codling moth, down from 93% in 2007. And 74% stated in 2009 that their recommendations of OP insecticides for codling moth had decreased over the past three years, up from 35% in 2007.

In 2009, consultants also perceived less leafroller damage, with 16% saying they found unacceptable damage 2 out of every 5 years or more, down from 69% in 2007. Accordingly, fewer consultants recommended Lorsban in 2009 (61%) than in 2007 (80%), and a higher percentage did not recommend any OP insecticides for leafroller in 2009 (25%) as compared to 2007 (13%).

In 2009, more consultants (69%) knew that 2012 would be the last year AZM could be used, up from 55% in 2007, and more answered correctly that the phase-out schedule would limit the total amount of AZM that could be used by a grower each year (52%, up from 32% in 2007). Thus, knowledge of the phase out had increased over time.

In 2009, more consultants felt that there were effective alternatives to AZM (mean score rose by 0.25 on a 1-5 scale, with 5 meaning "strongly agree"), and that the phase out would protect the health of agricultural workers (mean score rose 0.35) and the environment (mean score rose by 0.3). More consultants also felt that growers would bear the burden of the AZM phase out (mean score rose by 0.76), and that the cost and control of leafrollers would be more difficult after the phase out (mean scores rose by 0.38 and 0.43). Fewer consultants felt in 2009 that control of codling moth would be more difficult (mean score dropped by 0.27) or that tree fruit production would be riskier for growers (mean score dropped by 0.41) after the AZM phase out.

In 2009, slightly fewer consultants (62%) were interested in additional training on how to use AZM alternatives to manage pests than in 2007 (75%). This might be in part because more had already received training through AIPMTP and other venues.

Overall, it seems as though consultants in 2009 were more knowledgeable about and felt more in control of pest management in a world without (or soon to be without) AZM, and fears of codling moth damage

increasing alongside the phase out had dampened. Some of these differences between 2007 and 2009 data could be due to a larger sample size used in 2009 (120 of 200 surveys completed in 2009, compared to 40 of 73 in 2007), or perhaps to a greater representation of consultants working in the southern tree fruit regions (15% increase in representation from Yakima and the Tri-Cities in 2009) than in the north (16% decrease in representation from Wenatchee in 2009), but mostly they are likely to be due to consultants' increased experience working with AZM alternatives and with the success of AIPMTP efforts to provide resources for transitioning away from AZM (45% of consultants in 2009 had participated in an AIPMTP Implementation Unit, and 87% knew about the AIPMTP). This demonstrates significant benefit from AIPMTP outreach to consultants over the past several years.

Survey Comparisons – Apple Growers (2008) and Consultants (2009)

It is also possible now to compare the 2009 pest management consultant survey data with similar data gathered from apple growers in 2008, in order to see how consultants and growers differed (and at times how they answered similarly) with regard to their pest management practices, decisions, and thoughts. Highlight of this comparison are as follows:

Insect and insecticide questions

Growers in general seemed to perceive somewhat fewer pest problems in their orchards than did consultants. In 2008, 57% of growers found that codling moth caused unacceptable crop damage in their orchards, lower than the 81% of consultants who felt that way in 2009. Similarly, 21% felt that woolly apple aphid had caused damage, compared to 47% of consultants (in 2009).

Statement	2008 grower survey	2009 consultant survey
Codling moth caused unacceptable crop damage	57%	81%
Woolly apple aphid caused unacceptable crop damage	21%	47%
Codling moth never caused unacceptable crop damage	25%	4%
Growers used – consultants recommended AZM	83%	80%
Growers used – consultants recommended Imidan (phosmet)	31%	25%
Growers used – consultants recommended diazinon	8%	7%
Use of – recommendation of OP insecticides decreased	50%	74%
Use of – recommendation of pheromone mating disruption	65%	98%
Use of – recommendation of OP alternatives increased	47%	76%
Codling moth control cost more	76%	87%
Leafrollers never caused unacceptable crop damage	36%	18%
Knew that the last year of AZM use was 2012	35%	69%

While a similar percentage of consultants and growers (18% and 17%, respectively) felt that codling moth caused unacceptable damage every year, many more growers than consultants (25% compared to 4%) felt that codling moth never caused unacceptable damage in their orchards. Perhaps consultants get to see more evidence of damage when doing detailed monitoring or trap-checking in orchards, or perhaps they simply have lower thresholds on how much damage they consider acceptable.

Despite the finding that growers perceived fewer pest management problems from codling moth than consultants, growers and consultants reported similar spraying habits in 2008 and 2009 respectively. Specifically, 83% of consultants and 80% of growers reported using AZM, 31% of consultants and 25% of growers used Imidan, and 8% of consultants and 7% of growers used Diazinon, suggesting that growers do in fact generally follow their consultants' spray recommendations.

However, of the growers who sprayed AZM in 2008, 37% used two applications and 36% used three, compared to the two applications 61% of consultants used in 2009. Similarly, 50% of growers said their use of OP insecticides for codling moth had decreased over the previous three years, as compared to 74% of consultants in 2009. This higher number of spray applications and lower likelihood of reducing OP use among growers might be in part because the AZM phase-out was better known and further progressed in 2009, even though the EPA-allowed limit of AZM did not change between 2008 and 2009. It might also indicate a tendency among growers to spray more than consultants given an equal level of (perceived) damage. Here, growers used more OPs despite their lower perceptions of damage. Somewhat fewer growers used OP alternatives for codling moth as compared to consultants. For example, 65% of growers used pheromone mating disruption as compared to 98% of consultants, 54% of growers used Assail as compared to 74% of consultants, and 45% of growers used Delegate as compared to 83% of consultants. (Note, however, that Delegate was a new product in 2008 when growers were surveyed, and became more trusted by 2009 when consultants were surveyed.) Overall, 76% of consultants indicated that their recommendations of OP alternatives for codling moth had increased over the previous three years, compared to 47% of growers. These results again may indicate increasing adoption of OP alternatives with the passage of time from 2008 to 2009, or perhaps an increased rate of adoption among consultants as compared to growers.

With regard to codling moth injury levels, 68% of consultants and 57% of growers found that they had remained the same over the previous three years. And just slightly more consultants than growers (87% versus 76%) felt that the cost of codling moth control had increased accordingly over the previous three years.

Greater percentages of growers than consultants (24% of growers versus 7% of consultants) used the WSU-recommended 1 pheromone trap per 2.5 acres or less for monitoring codling moth density. Instead, consultants used 1 trap per 2.6-5 acres (39%) or 1 trap per 5.1-10 acres (45%). More growers than consultants (18% of growers versus 1% of consultants) did not use pheromone traps at all. Thus, while consultants are more likely to use pheromone traps, growers are more likely to use them at higher (recommended) densities. If consultants are placing these fewer traps in areas of higher codling moth pressure (either unintentionally or to better monitor these hotspots) this might contribute to consultants' higher perceptions of codling moth injury, damage, or presence.

Fewer growers than consultants used the battery of IPM practices surveyed than consultants. For example, 93% of consultants monitored their fields for damage often, compared to 81% of growers. Similarly, 90% of consultants used degree day models often, as compared to 65% of growers, and 83% of consultants used resistance management strategies often, as compared to 43% of growers. Fewer growers than consultants indicated that their use of these IPM practices had increased over the previous three years (62% of consultants versus 32% of growers for resistance management strategies, 41% of consultants versus 26% of growers for field monitoring, and 38% of consultants versus 27% of growers for degree day models).

Growers were also less concerned about leafrollers than consultants, with 36% of growers and 18% of consultants asserting that leafrollers never caused unacceptable damage. Among growers, 20% expected less than 1% damage if no controls were applied, as compared to 9% of consultants. However, more

consultants than growers (49% compared to 26%) felt that leafroller injury had decreased over the previous three years.

Consultant use of OP insecticides for leafroller was lower than grower use, with 25% of consultants and 12% of growers stating they did not use or recommend any OPs for leafroller control. More growers than consultants also reported spraying AZM (30%, compared to 5% of consultants) and Imidan (14%, compared to 4% of consultants) for leafroller, whereas levels of Lorsban (59% and 61% respectively) and Diazinon (5% and 3% respectively) were similar.

Like with codling moth, fewer growers than consultants used various IPM practices and/or OP alternatives for leafroller. For example, 75% of consultants used or recommended Delegate compared with 41% of growers and 62% used Intrepid compared to 32% of growers; note, however, that more growers than consultants (48% versus 36%) used horticultural mineral oil. Fewer growers reported increasing their use of OP alternatives for leafroller over the previous three years (25% compared to 37% of consultants). This again may indicate a slight hesitance among growers to adopt newer products, even perhaps when recommended by their consultants.

Phase-out and information source questions

- Similar percentages of growers and consultants (99%) knew about the AZM phase-out. However, more consultants (69%, compared to 35% of growers) knew that 2012 was the last year AZM could be used and 52%, compared to 42% of growers, knew that the phase-out would limit only the total amount of AZM used per year (rather than number of applications or timing).
- Accordingly, most consultants (72%) and growers (65%) were in the process of reducing their use of AZM at the time they were surveyed. However, more growers than consultants (14%, compared to 6%) reported not having yet begun to reduce AZM use.
- Consultants expressed higher confidence ratings in their knowledge of how to use OP alternatives (on a scale of 1-5 with 5 being very confident, consultants averaged 4.7 for pheromone mating disruption compared to 3.8 for growers, 4.3 for Assail compared to 3.5 for growers, and 4.3 for Altacor compared to 3.0 for growers). As discussed above, these results may reflect consultants having had more practice with OP alternatives and the AZM phase-out in 2009 than growers did in 2008, or they may reflect greater facility and familiarity with new pest management practices among consultants than among growers.
- Nevertheless, more consultants reported barriers to using OP alternatives than growers. While 83% of consultants thought alternatives were too expensive, only 68% of growers felt that way; while 73% of consultants worried that alternatives caused other pest problems, only 42% of growers felt that way; and while 64% of consultants were concerned that export markets might not accept fruit with alternative insecticide residues, only 30% of growers expressed that concern. However, similar percentages of growers and consultants felt that alternatives' level of effectiveness and timing of application were barriers to their adoption (but both were seen as lesser barriers than those above). More growers than consultants (14% compared to 5%) stated that they did not face barriers to using OP alternatives. Thus, while fewer growers use OP alternatives than consultants, fewer perceive the barriers to adoption of these products that consultants do.
- While growers and consultants agreed upon many of the opinion statements presented to them in their respective surveys, growers felt more strongly that phasing out AZM would make tree fruit production riskier for growers (mean score 0.33 higher for growers than for consultants on a 1-5 scale where 5 means "strongly agree"), that the cost and control of leafrollers would be more difficult after the AZM phase out (mean scores 1.04 and 0.76 points higher for growers than consultants), and that the phase out would require significant retraining of agricultural workers (mean score 0.21 points higher than for consultants). Growers were also less convinced that they had effective alternatives to AZM available

(mean score 0.52 points lower than for consultants) and that WSU had developed good information on AZM alternatives (mean score 0.3 points lower than for consultants). Thus growers were more worried than consultants about production challenges, especially for leafrollers, and were less sure that there were adequate remedies for these challenges.

- With regards to secondary pests, growers reported fewer problems than consultants, with 44% of growers saying woolly apple aphid problems had increased over the previous three years (compared to 87% of consultants), and 17% (compared to 68% of consultants) saying that spider mite problems had increased.
- More growers placed responsibility for insect monitoring on their own heads than did consultants. Whereas 84% of consultants felt that they (consultants) were responsible for monitoring and only 38% felt that growers or managers were responsible for monitoring, 72% of growers named themselves responsible for monitoring. And fewer growers than consultants reported barriers to monitoring (40% versus 53% for lack of time and 21% versus 33% for lack of trained staff).
- The top three sources of information growers used for making pest control decisions were agricultural chemical distributor fieldmen (mean score of 4.20 on a scale of 1-5 with 5 being “very important”), WSU Crop Protection Guide (3.67), and insecticide label information (3.53), followed by conferences, workshops, or seminars, and WSU researchers. For consultants, the top three sources were the WSU Decision Aid System (4.32), WSU Crop Protection Guide (4.17), and other professional consultants (4.08), followed by insecticide label information and WSU researchers. Thus WSU resources were important to both consultants and growers, with growers also relying most heavily on advice from their field consultants.
- Of growers, 37% used the WSU Decision Aid System (DAS) compared to 90% of consultants, and 53% knew about the WSU Pest Management Transition Project (PMTP) compared to 87% of consultants (17% of growers, compared to 45% of consultants, had participated in a PMTP Implementation Unit). In addition, 37% of growers knew about using USDA Environmental Quality Incentives Program (EQIP) funds for integrated pest management compared to 67% of consultants. Both growers and consultants were equally interested in additional training on how to use AZM alternatives (62%).
- In terms of orchard demographics, growers owned, operated, or managed an average of 193 acres compared to a mean 1875 acres visited by consultants. Similar percentages managed orchards organically or in transition to organic (11-12%), conventional with use of OPs (62-67%), and conventional without use of OPs (23-30%). Demographically, similar percentages of consultants and growers were between 45 and 64 years of age (62-64%), although the remainder of growers were generally older (22% aged 65 and up) and the remainder of consultants were younger (36% under 45). While similar percentages of growers and consultants came from farming backgrounds (68-74%), consultants were more likely to have a four-year college degree than growers (68%, compared to 35%).

Overall, despite some similarities, apple growers in 2008 seemed slightly less comfortable with the AZM phase-out and introduction of OP alternatives than consultants. As mentioned previously, this may be due to the progress of the phase out from 2008 to 2009 and/or to differences between consultant and grower experiences and perspectives. Nevertheless, growers were more likely to see certain of the aspects of the transition, from pest problems to barriers to adoption of new technologies, in a somewhat more positive light than consultants. Results also lend credence to the role that WSU programs like AIPMTP and DAS have played in helping especially consultants adapt to the pest management transition. Many of these resources have also helped growers, either directly or likely through the medium of their relationship with their consulting fieldmen. Results argue for continued assistance to both groups, in accordance with their levels of knowledge and interest.

Preparations are underway now for a 2010 apple grower survey for January 2011, whose results will be compared with results from the 2008 grower survey and 2007 and 2009 consultant surveys, in order to see how grower attitudes have shifted over the period of the AZM phase out.

DAS User Survey 2010 - Results Summary

- Participants: 154 participants answered our voluntary user survey (= 34.4% of 447 users that logged in at least 3 times in 2010; 134 participants completed all questions; 26.8% of the responders also participated in the 2008 survey (50.3% did not participate in 2008; 22.9% do not remember if they participated in 2008).
- Year of registration: 40.3% of the survey participants started using DAS within the last 2 years (14.8% in 2010, 25.5% in 2009, 31.5% in 2008, and 28.2% in 2007). (Note: 149 responses total)
- User age: Similar to the survey results from 2008, the majority of DAS users in the 2010 survey is above 50 years of age – 63.6% (3.2% are 29 years or younger; 10.4% are between 30 and 39; 22.7% are between 40 and 49; 43.5% between 50 and 59; and 20.1% are 60 years or older.)
- User gender: 92.2% of the survey participants were male, 6.5% female, 1.3% declined an answer. (This distribution is similar to 2008 when 87.9% DAS users were male and 10.1% female. 2.0% declined.)
- Educational background: The educational background of DAS users in the 2010 survey is the same as in 2008, with the majority (66.2%) of users having a 4-year degree or higher, followed by some college (15.6%), a 2-year degree (11.0%), high school/GED (4.5%), and trade school (2.6%).
- Language: Spanish is the first language of 5 (3.3%) survey responders (English 96.1%; 0.6% declined). 14 participants (10.1%) said they were interested in using DAS in Spanish.
- User occupation: The majority of the survey participants are growers/orchardists (60.8%), 37.9% are orchard managers, 20.2% work as Ag Chem distributor consultants, 16.3% are Packinghouse/ Company fieldmen, 13.7% work in research and/or extension, 9.8% work as private crop consultants, and 9.1% have other occupations. (Note: Users could check multiple answers for full- and part-time occupations.)
- How easy is DAS to use: Most users rated the use of various features of DAS as easy or very easy. The average rating on a scale from 1 (= very easy) to 5 (= impossible without help) for first time registration, setting up a user profile, editing the user profile, viewing model results, viewing model charts was 1.8, 1.9, 1.9, 1.6, 1.7, respectively. On average, survey participants rated viewing the full WSU Spray Guide, changing the output in the full WSU Spray Guide, using the filter in the full WSU Spray Guide, using the DAS Help Center, and using the Historic Weather Data Center as 1.8, 2.0, 2.0, 2.0, and 2.2, respectively. Between 6.2% and 27.4% of users indicated that they were not aware of the latter 5 features. The survey participants rated the various insect, disease and disorder models between easy and very easy to use.
- How useful are features on DAS: Various features on DAS were rated on average between 1.3 and 1.9 on a scale from 1 (= very useful) to 3 (= not useful; 2 = somewhat useful). Best average ratings were given to projected model forecast with management recommendations, model charts, and the overall full WSU Spray Guide. Compared to 2008, survey participants rated the usefulness of DAS features the same (management recommendations, projected model forecast with management recommendations, and natural enemy effects in Spray Guide) or slightly better (model charts, full WSU Spray Guide, and pesticide efficacy/secondary pest effects in Spray Guide). New features, such as video tutorials, online manual, front page stories, and iPhone version were rated on average as 1.8 or 1.9 (somewhat useful).
- Impact of DAS: The majority of survey participants (56.0%) indicated an increase in the level of pest control due to the use of DAS; 29.0% saw no change and 7.0% reported a decrease in pest control level (8.0% answered “not applicable”). The impact of DAS on the number of sprays and management costs increased from 2008 to 2010. In 2010, the use of DAS decreased the number of sprays for 36.0% of survey participants compared to 23.6% in 2008. The number of sprays increased for 11.0% and did not

change for 45.0% of the survey participants in 2010 (8.0% answered “not applicable”). In 2010, the costs for pest management decreased for 31.0%, compared to 13.4% in 2008, increased for 17.0%, and remained the same for 39.0% of DAS users (13.0% answered “not applicable”). Furthermore, in 2010 a higher percentage of DAS users indicated that DAS helped with pest management decisions compared to the 2008 survey. In 2010, DAS helped 97.0% of the survey participants to some or a very great extent with clarifying treatment timings (2008: 79.5%), 68.0% with choosing chemicals for best efficacy (2008: 26.0%), 65.0% with clarifying management for multiple pests (2008: 38.6%). In addition, 86.0% of the survey participants feel that DAS helped with improving their overall management strategy, with providing general information on IPM (86.0%), and with choosing chemicals to reduce natural enemy mortality (60.0%). (Note: 100 total responses for this question)

- We also asked how the user’s operation would be affected if DAS was discontinued next year. The majority of survey participants indicated that the discontinuation of DAS would have major or modest impacts on the user’s number of sprays (21.4% “major”, 49.0% “modest”, 29.6% “no impact”), costs for pest management (17.3% “major”, 54.1% “modest”, 28.6% “no impact”), level of pest control (31.6% “major”, 43.9% “modest”, 24.5% “no impact”), on the clarity of treatment timings (58.2% “major”, 36.7% “modest”, 5.1% “no impact”), the user’s choice of chemicals for best efficacy (11.2% “major”, 53.1% “modest”, 35.7% “no impact”), choice of chemicals to reduce natural enemy mortality (12.3% “major”, 45.9% “modest”, 41.8% “no impact”), management for multiple pests (20.4% “major”, 51.0% “modest”, 28.6% “no impact”), and improvement of the user’s overall management strategy (34.7% “major”, 53.1% “modest”, 12.2% “no impact”). (Note: 98 total responses for this question)
- Sharing information: 48.3% of the survey participants said they were asked for information from DAS, and 81.4% of all survey participants share the information with others.
- How did users learn about DAS? The majority of users learned about DAS through grower meetings (58.4% in 2010), followed by PMTP meetings (31.8%), Good Fruit Grower articles (26.6%), friends/colleagues (25.3%), employer/supervisor (16.9%), internet links/search engine (11.7%), and/or other sources (13.6%). In 2008, grower meetings were also identified as main source for DAS promotion (55.1%).
- How would users like to learn more about DAS? 66.2% of the participating DAS users would like to learn more about DAS. The preferred ways of learning were newsletters and updates on the DAS front page (63.0%), followed by online video tutorials and manual (53.3%), grower meetings (42.4%), and workshops (39.1%). Other suggestions included online workshops and interactive online training.
- DAS support: Almost half of the survey participants (45.6%) have requested any kind of support from the DAS team and rated the responsiveness, helpfulness, and friendliness good or excellent (100%, 95.2%, and 100%, respectively).
- Computer experience/proficiency: Twice as many DAS users said they use smart phones or PDA’s in 2010 (50.6%) compared to 2008 (27.5%). In the 2010 survey, a slightly higher percentage of DAS users has experience with Email (96.8% vs. 90.7% in 2008) and spreadsheets and/or word processing (83.1% vs. 81.4% in 2008). 90.9% of the survey participants reported to have experience with web browsing (not asked in 2008). In 2010, more users consider themselves as computer experts (16.9% vs. 10.9% in 2008). 73.4% describe themselves as average user (78.5% in 2008), and 9.7% as novice (10.5% in 2008).
- Computers used: The percentage of users using desktop computers (82.5%), laptops (77.3%) has increased compared to 2008 (79.3% and 60.7%, respectively). The use of smart phones/PDA’s has more than doubled (44.8% vs. 20.2% in 2008).
- Acreage: The survey participants from WA State provide pest control management or recommendations for a total of approximately 182,044 acres in 2,909 orchards. In 2008, survey participants provided management or recommendations for a total of 250,094 acres in 2,888 orchards, where the industry size

estimates are 3000 orchards and 218,000 bearing acres (Noncitrus fruits and nuts 2009 summary, July 2010. NASS). (Note: 151 total responses for this question, 100 responses from WA State)

- Management practice: The majority of survey participants describes their management practice as conventional (81.5%), followed by organic (38.9%), non-OP (35.2%), and other (6.5%) including “sustainable”, “BMP”, “IPM based”, “reduced risk pesticides”, “prefer organic, but not certified”, “international organic”, and “Nutri-Clean.” (Note: 108 responses total, multiple answers possible)
- Crops: Of the survey participants from WA State that provide management or recommendations, 92% do so for apples, 63% for pears, 69% for cherries, 32% for other stone fruit, and 11% for other crops including grapes or other small fruit. (Note: 100 responses total from WA State, multiple answers possible)
- Crops used in DAS: All crops are used in DAS by the survey participants, most importantly apple (92.1%), followed by cherry (70.6%), pear (61.5%), and other stone fruit (34.3%). Percentages of crops used in 2010 are very similar to 2008, whereas the percentage of people using cherry on DAS slightly decreased (98.4% apple, 80.3% cherry, 58.3% pear, 34.6% other stone fruit). (Note: 143 responses total, multiple answers possible)
- Models used in DAS: The most used models on DAS are codling moth (93.0%), fireblight (79.7%), western cherry fruit fly (65.0%), oblique-banded leafroller (63.6%), cherry powdery mildew (58.7%), and Pandemis leafroller (54.5%). Compared to 2008, the leafroller models switched places (OBLR 29.1%, PLR 60.6%), and new models have been added, such as the models for cherry powdery mildew, oriental fruit moth, and sunburn browning.
- For 62.2% of the survey participants, the codling moth model was the most important model, while for 21.5% fireblight and for 5.2% western cherry fruit fly is the most important model. The second most important model is fireblight for 31.1%, codling moth for 23.0%, and western cherry fruit fly for 11.1% of the users. The third most important model was western cherry fruit fly for 19.3%, cherry powdery mildew for 12.6%, and oblique-banded leafroller for 11.1% of the users. In comparison to 2008, the ranking for the first and second most important models has not changed. Added after 2008, the cherry powdery mildew model is one of the three most important models now.
- Number of stations used in DAS: The majority of users (77.3%) looks at 1 to 5 weather stations, the remaining survey participants use between 6 and 134 stations. In 2008, 65.3% users looked at 1 to 5 stations, while the maximum number of stations used was 25.

Washington Apple Commission
Global Retail Training in Produce Layout Design & Handling

PROJECT SUMMARY

By the time Washington Apples, Northwest Pears, Northwest Cherries and Washington State Potatoes (cooperators) reach the retail shelves in foreign markets, they are high value items that, if mishandled, can cause significant losses to the store's produce department. This makes retailers hesitant to handle the product and in turn can mean limited opportunities through these important market sales channels.

Modern retailers (hypermarkets and supermarkets) in developing markets have limited exposure to the design layout and merchandising ideas of US fresh produce in their stores. Most of the fresh produce sections in these outlets are not designed to maximize sales. In addition, produce handling and training need to be intensified at the store level since most retail produce staff lack proper handling and merchandising skills. Modern retailers are increasing their share of fresh produce sales at the expense of traditional wet markets. Improved produce handling and display will accelerate this process. High quality Washington Apples, Northwest Pears, Northwest Cherries and Washington Potatoes were major beneficiaries of market share growth by the modern retail sector with our longer shelf life, better appearance, and timely delivery versus cheaper source origin produce that lacks the high quality image and characteristics of US produce.

WAC requested SCBGP funds to be used to provide training to key retailers in at least 6 emerging markets (Russia, the Middle East, India, Mexico, China and Thailand) in produce department layout design and produce handling, including follow-up display contests and evaluations. WAC contracted with John Baker of Produce Marketing Australia, a representative of the US Produce Marketing Association, who is an accredited trainer with extensive background in care, handling and merchandising of produce items. Training was preceded by a store visit so the consultant could understand strengths/weaknesses of the chain's current approach. To strengthen the training, co-operator in-country representatives worked with the PMA consultant and the retail chains to conduct produce department display contests to allow the participating retailers to incorporate the training into practical applications.

Recognizing that one of the main keys to maintaining the quality of Washington apples is correct care and handling practices, WAC has attempted to educate both importers and retailers throughout the marketing regions, particularly in less-developed countries. They have found that as the retail infrastructure develops, so do the opportunities for Washington apples and other high value specialty crop items like Northwest pears and cherries. The follow-up retail display contests were implemented with at least one retail chain per market (except in Russia where this type of promotion is not generally allowed by retailers). This provided incentive to utilize the training provided in a practical way to maximize the benefits to Washington apples, pears, cherries and potatoes.

During the 2008-09 season, FY08 SCBGP funds were used to conduct training seminars in China and India, two countries that offer tremendous growth opportunities for Washington apples and other tree fruits. Both projects involved training seminars with key retailers in major cities such as Shanghai, Guangzhou, New Delhi and Mumbai and were able to reach over 240 retail produce managers from 10 retail chains in China and 150 participants from 11 retail chains in India. Feedback from participants was very positive, with 85% of evaluation forms turned in and averaging 4.3 out of 5 for workshop quality and relevance. Although it is too early to tell whether WAC will achieve the goals of 3 chains in India renovating their produce sections this year, at least one chain in India did follow up on their own with a retail promotion based on the information provided in the seminar.

In the follow-up display contest in China with the Park n Shop chain using FY08 SCBGP funds, the participating stores, on average, were able to increase Washington apple display space from 2.5 square

meters before the promotion to 6 square meters during the promotion at each of the 30 participating stores (a 140% increase). The total sales volume was 8,812 cartons during the display contest promotion, up from the sales volume of 2,516 cartons during the 4-week period before the display contest, surpassing our goal of a 50% increase. As a result of the tremendous growth of the sales volume of the Washington apples during the event, the importers increased the supply to the retail chain and made a handsome profit even though they had to slightly reduce the price as a contribution to the promotion. The promotion successfully helped to increase the confidence of importers and retailers in selling more Washington apples. However, because of the rapid expansion and development of the retail infrastructure in these countries, as well as the other targeted markets for this project, continued training is needed. In India and China this would mean targeting the major distribution centers as well as second tier cities that play a strategic importance to future sales opportunities.

PROJECT APPROACH

The Washington Apple Commission (WAC) commissioned John Baker of Produce Marketing Australia to deliver a series of retail training programs in China, Russia, Mexico, Thailand, India and the Middle East. The program outline included:

1. Conduct store visits (at least one per retailer) and visit retail outlets for each of the participating retailers to assess:
 - a. Current performance with the participating products, especially apples
 - b. General store layout and performance in fresh produce (front and back) - receipt, storage, handling, cold chain, food safety, product range, display, promotions etc
 - c. Meet with store staff to determine:
 - i. Profile of customer base – how often and when (time of day) do they shop for regular items (top up), discretionary products (and what are they) and impulse items. This has implications for where imported products fit (e.g. “Fresh @ 5” merchandising if shopping is later in the day, etc.)
 - ii. Existing levels of knowledge and information in the areas to be covered
2. Conduct workshops (half day) customized for each participating retailer (or collectively for smaller retail groups) that included:
 - a. Product and merchandising information that may include the following products: Washington apples (the main emphasis), USA pears, Northwest cherries, table grapes, berries, summer fruit, Washington potatoes, carrots and onions
 - b. Information on cold chain and food safety requirements; trends in fresh produce; developments in organics
 - c. Retail concepts and ideas from other markets (USA, Australia, New Zealand, etc.) that could be applied in the targeted markets.
3. Follow up with store visits (half-day) to participating retailers to provide further guidance on practical applications of information from workshops, clarify any issues raised in implementation of the training and provide feedback.
4. Prepare all resource materials and make available to participants: product specific and generic information; store concepts and any other relevant training materials in English. All translations, printing and distribution were handled by WAC.
5. Provide a written report at the end of the project with an evaluation of pre and post- project merchandising and handling activities of the participating retailers, with recommendations for follow-up activities for both WAC and/or any participating Agricultural Trade Office staff. Participant evaluations were used to assist in this evaluation, including:
 - a. “open book” assessment by attendees at conclusion of each workshop, to reinforce key messages and assess level of knowledge achieved
 - b. Participant survey of value and effectiveness of workshops and materials.

6. In markets where appropriate, the WAC representative orchestrated a display contest competition which will enable the participants to use the skills they learned in the seminars to build effective displays.

Project partners for the workshops included the Washington Apple Commission, Pear Bureau Northwest, the Washington State Fruit Commission/Northwest Cherries and the Washington State Potato Commission. Each partner provided information and input into the workshop training materials and were active participants in applicable markets.

GOALS AND OUTCOMES ACHIEVED

The workshops conducted included:

- China - six workshops, including two workshops each in Shenzhen, Shanghai, and Beijing in November and December 2009 with 231 participants attending
- Russia - five workshops, including three workshops in Moscow and two workshops in St Petersburg in January 2010 with 139 participants attending
- Mexico - three workshops for the retailer Soriana held in February 2010 with 128 participants attending
- Thailand - five workshops in Bangkok in March 2010 with 255 participants attending
- India - five workshops in Kolkata, Bangalore, Pune, Ahmedabad, Amristar in March 2010 with 148 participants attending
- Middle East - five workshops in Dubai, Sharjah and Abu Dhabi in April 2010 with 105 participants attending
- Sri Lanka/India – eight additional workshops in Sri Lanka and India in January and February 2011 with 352 participants attending

The workshops were personalized for the participating retailers to be able provide instruction on how to improve their produce departments layout and the handling of the produce.

The immediate goal of the produce handling training was to increase the sales of Washington State Apples (and other fruits) to the participating retailers by 10% during the 3 month timeframe following the training by increasing their profitability and/or “value-added” benefits provided. In general, there was an average increase of 129% over the 6 markets, with the highest increase seen at the O’key supermarket chain in St. Petersburg, Russia (346% sales increase). The lowest increase was seen in the Carrefour chain in Thailand with only a 6% increase.

Incremental success was also measured by the number of tactics adopted by the training participants, including:

- Reduction of shrinkage/wastage of participating commodities by 2% among participating chains through proper storage, handling and rotation practices. This was more difficult to determine, as some stores were not willing to share direct numbers, however based on the data received, WAC was able to almost double their original goal of 2% to 3.9%. In general China showed the best increases with one participating store registering an 8% reduction of shrinkage/wastage after the training.
- Increase in display shelf space for participating commodities by 5-10% (varies by time of year) through the use of good merchandising practices. Based on the data gathered, WAC was able to achieve an average of 8.65% increase in display space following the training.

Although all of the measurable outcomes were able to be quantified in the 3 months following the training, WAC expects the training impacts to carry through to future seasons. In the case of Russia, due to the long transit time (up to 2 months) and timing of the seminars, several of the participating retailers decided to purchase Washington apples as a regular stocked item in the following seasons, rather than only filling in if other origin supplies were not available.

WAC is pleased that they have been able to surpass their targeted goals for the project.

In addition to the stated measurable goals, WAC has also been able to improve their relationship with the participating retailers, which is difficult to quantify but critical in terms of the ability to implement promotional programs and increase sales. As reported by their Middle East representative “The pre- and post-training workshops were very popular and were an excellent way to develop commercial relationships with potential and current customers. Once sales force personnel are well-trained and convinced of the quality of these products, they become more effective promoters of our products each working day at the point of purchase. The multiplier impact of this training program is very significant. The “value-added” benefits provided by the training generated goodwill among participants from all retail formats.”

In order to gauge the effectiveness of the training and determine progress towards WAC’s goals, in-country representatives obtained shrink/wastage and display space data from participating retailers both before the training and three months post-training. Sales of the participating products were also measured to determine the increase in sales after the training.

BENEFICIARIES

This project directly benefited Washington apples, Northwest pears, Northwest cherries, and Washington potatoes. Based on the average export values and total volume, WAC estimates the impact of the training to be in excess of \$17 million FOB value on the respective industry shipments to the participating retailers. This assumes that the participating retailers continued to use the good handling practices learned in the training for the duration of the season.

A large number of retailers also benefited from this project. Retail participants in each country included: Jusco-China; CRC Vanguard/Ole-China; Lotus-China; E-Mart-China; BHG-China; Carrefour-China; Metro Cash & Carry-Russia; Union of Independent Retailers-Russia; Azbuka (Alphabet of Taste)-Russia; Carousel-Russia; Lenta-Russia; O’Key-Russia; Land-Russia; Soriana-Mexico; Big C-Thailand; Tops-Thailand; Carrefour-Thailand; Siam Makro-Thailand; Tesco-Lotus-Thailand; Spencers-India; Metro Cash & Carry-India; Big Bazaar-India; Garden Fresh-India; Aditya Birla Retail (More)-India; Namdhari-India; Foodworld Supermarkets-India; Heritage Foods-India; Reliance-India; Spar Hypermarkets-India; Fresh & Fresh-India; Nature’s Basket-India; AB Retail Chain-India; Star Bazaar-India; Agri Fresh-India; Best Price (Bharti Wal Mart)-India; Hyper City Retail-India; T Choithram & Sons-Middle East; Union Co-ops-Middle East; Sunrise City Supermarkets-Middle East; Al Maya Group Supermarkets-Middle East; Spinneys-Middle East; New West Zone-Middle East; Waitrose-Middle East; Geant-Middle East; Emirates Co-op-Middle East; Lulu Hypermarket-Middle East; Giant/Safestway-Middle East; Lifco-Middle East; Abu Dhabi Coop-Middle East; and Union Co-ops-Middle East.

LESSONS LEARNED

This was the second round of training that WAC conducted using SCBGP funds and they were able to incorporate some of their lessons learned from the previous project to improve this training.

Modifications to the presentation included highlighting the superior quality and growing conditions of Washington Apples, Northwest Pears, Northwest Cherries and Washington Potatoes in order to maximize the training opportunities to educate the retailers regarding these products.

Timing continues to be critical, as the trainings ideally should be conducted while products are available in the market. In Russia, due to the transit time of almost two months, three of the four participating retailers said that although they were unable to increase their volumes in the current 09-10 season, they were planning to do so during the 2010-11 season.

There continues to be a high demand for this type of training, particularly in markets with quickly growing retail sectors such as China and India. Mexico was more challenging – the modern retail sector is more developed, and it was difficult to get management to allow their store personnel to take almost a full day off for training. In the end we were only able to get one retailer, Soriana, who was willing to participate. With the high demand in other markets, we would not repeat the training in Mexico.

As noted above, there were several positive results, most dramatically the commitment of all four participating Russian retailers to increase the volume of Washington apples that they carry as a result of the training. As an example, the Lenta chain from St. Petersburg has committed to purchasing Washington products separately as a special category, whereas before this seminar and communication/facilitation with WAC, the chain was making purchases of any red apples on the tender bases, so Washington apples were sourced only if no other product was available. The seminars also allowed correcting problems with the mislabeling of Washington apples in this chain. Before the training, Washington apples were often labeled as apples of Argentinean, Chilean, European and other origin.

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ADDITIONAL INFORMATION

Matching Funds for this project totaled \$35,414.78. This amount consisted of travel expenses for local representatives, prizes for display contests, apples for sampling, and meals provided during the seminars.

Ecotrust
Increasing Efficiency and Market Access with FoodHub

PROJECT SUMMARY

In October, 2009 Ecotrust received \$250,000 to support their project titled: *Increasing Efficiency and Market Access with FoodHub*. This has been a multi-state project serving specialty crop producers in Oregon and Washington.

FoodHub is an online directory and marketplace that makes it easy and efficient for buyers and sellers of regional food to find one another, connect, and conduct business. For chefs, restaurateurs and food service directors, FoodHub translates to fast foraging— they can find regionally-produced products quickly and easily, get background on producers and make direct contact with the click of a button. For farmers, FoodHub means marketing made easy— they can develop sales leads and promote their specialty products to professional food buyers interested in sourcing from within the region.

The purpose of this project was to enhance the competitiveness of specialty crop markets in Washington and Oregon by resolving distribution and business bottlenecks that limit commerce among specialty crop producers and buyers. The project's specific objectives were to:

1. Provide specialty crop producers a simple way to provide general information about their business and market themselves, their stories, and their products.
2. Provide food buyers a simple way to provide general information about what they typically buy (allowing specialty crop producers to do market research), access information about specialty crop producers, and order specialty crops based on specific requirements (e.g. certification, proximity, distribution model, and price).
3. Diversify and create new market opportunities for specialty crop producers by increasing the number and types of food buyers purchasing their products.
4. Increase specialty crop producers' total volume or dollar value of sales.

Funding for this project was provided by the Specialty Crop Block Grant Programs (SCBGP) administered by the Washington State Department of Agriculture (WSDA) and the Oregon Department of Agriculture (ODA).

While the market for locally-grown food was once largely the domain of high-end restaurants, food buyers of all types are increasingly interested in purchasing locally or regionally grown products. These larger-volume and institutional buyers —such as public schools, hospitals, food service providers on college and corporate campuses, and retail stores— now have 'authenticity requirements' in addition to long-standing cost, quality, quantity, and delivery requirements.

Washington (WA) and Oregon (OR) specialty crop producers, with their reputation for high quality and significant production capacity, are in a unique position to capitalize on this burgeoning market. However, Ecotrust's in-depth exploratory research found that key structural barriers exist that limited specialty crop producers' ability to access this market, including the following:

- Most larger-volume purchasers source product through wholesale distributors such as Food Services of America, Sysco, and other broadline distributors.
- Specialty crop producers typically cannot individually meet the minimum order (volume) and uniformity requirements of these wholesale distributors.
- It is often infeasible for larger-volume purchasers to do business outside of their current, streamlined, supply chain model. For instance, many buyers can't receive multiple deliveries of products from individual suppliers throughout the week, or manage receipt and payment of multiple invoices from various individual producers.

- Highlighting production methods and authentic farm stories is often a key marketing strategy for specialty crop producers who seek to differentiate their products. Yet, sales to traditional wholesale distributors often result in a discontinuity of information flow, negating opportunities for many producers to receive compensation for the attributes and stories that differentiate their products.

Indeed, a product description and an SKU code are often the only information buyers have to inform their purchasing decisions. Yet in the age of product recalls, the ability to trace food back to its original point of origin is a business imperative. Moreover, being able to share the rich stories behind our food—the names of the farmers’ kids, what led the farm family to switch to organic practices, how they knew when to harvest the cherries for maximum sweetness, which sweet onion producer always takes the blue ribbon at the county fair—provides a crucial competitive advantage to all those who merchandise locally/regionally grown specialty crops.

FoodHub was designed to serve a wide range of specialty crop producers in both OR and WA, and over the course of the funding period has been refined and improved based on close collaboration with these members. Ensuring efficient market access and regional competitiveness for these crops is vital to the states’ agricultural economies. From the small farmers’ market vendor to the many larger members of a well coordinated tree fruit association or packing house, FoodHub accommodates a wide range of specialty crop producers as well as buyers. At every scale of operation, FoodHub provides business efficiencies and marketing opportunities that were not previously available.

This project was not previously funded by WSDA. However, as noted above, this is a multi-state project serving specialty crop producers in Washington and Oregon, and it had been supported by ODA SCBGP funding through two consecutive one-year grants, in FY08 and FY09. The project has also leveraged U.S. Department of Agriculture (USDA) Rural Development funding for FoodHub research and technical development activities, through both the Rural Business Enterprise Grant (RBEG) and Rural Business Opportunity Grant (RBOG) programs. One reason that FoodHub has been so enthusiastically embraced throughout the region is that it complements, rather than duplicates, existing efforts and is well integrated with other economic development activities throughout the state.

Each grant that has supported FoodHub has a specific scope of work that is defined based on collaborative planning amongst FoodHub staff and project partners, and that responds to the particular needs of the tool’s stage of development. From the beginning, FoodHub has been developed in close consultation and collaboration with colleagues and partners throughout Washington and Oregon, including government agriculture agencies, farmers and producer groups, non-profit organizations, and private businesses. Each of these partners have been actively involved in all stages of development, from early design concepts to the project’s work plan and business requirement, to project evaluation and future planning. This has ensured that the project unfolds in a stepwise, strategic fashion that incrementally builds on previous work in a comprehensive overall project plan. At the same time, a critical element of FoodHub’s success as a tool for specialty crop producers and buyers, as well as other users, is its ability to nimbly respond to the feedback of our members. The close involvement of partners throughout the process has provided vital feedback that informs the considered evolution of FoodHub’s ongoing work plan.

PROJECT APPROACH

Project activities summary

This project, *Increasing Efficiency and Market Access with FoodHub*, builds on several years of work by Ecotrust as well as numerous initial investments by individual, corporate, government, and foundation sources. As a result of this groundwork, Ecotrust had several fundamental pieces of the project in place at the time of their original proposal to WSDA: complete technical development of directory and search

features, a business plan, and strong partnerships throughout the region with many other groups who were vested in FoodHub's success. Throughout the project, they built on this strong foundation through a range of activities:

- Engagement of Ecotrust's network of partners, including government and nonprofit organizations, business, professional and trade associations, and individuals.
- Close personalized work with "early adopters", such as participants in Ecotrust's longstanding *Guide to Local and Seasonal Products for Oregon and Washington*, to establish FoodHub's initial membership base representing a wide variety of users.
- Involvement of key partners and allies throughout the region in FoodHub Ambassador program, which helped to provide information about FoodHub within specific groups and geographic areas, and assistance with recruitment and registration of FoodHub users.
- Targeted outreach and marketing efforts to recruit, train, and support FoodHub members, including on-site training sessions specific to specialty crop producers and buyers, promotion of the tool at farm conferences and meetings of trade associations and professional food buyers.
- Mid-point evaluation of FoodHub's business model and strategies, incorporating an analysis of feedback and data from FoodHub's current membership and stakeholders as well as research regarding other internet business models and best practices relevant to FoodHub.
- Development of new technical features, including iterative usability testing and modification.
- Development of customer incentive and referral programs to promote user-to-user recruitment.
- Implementation of a monitoring and evaluation system, including focus groups, surveys and website mechanisms to solicit ongoing FoodHub user feedback.

During the project period, Ecotrust launched three versions of FoodHub (detailed below), each one adding improvements to existing functionalities and introducing new features. They also conducted outreach campaigns to create broad awareness of FoodHub, featuring on- and offline marketing, advertising, public relations, event sponsorship, and public speaking. A specific focus of strategic public relations outreach was an emphasis on both consumer and trade publications, to raise the profile of FoodHub's utility for specialty crop producers and buyers.

Project accomplishments and results summary

Technical development: After significant development of technical functionality, FoodHub launched in a limited release beta form on November 1, 2009. This provided invaluable user feedback on the system, much of it captured through the "feedback" button that appears pinned to the left border throughout the site in order to encourage on-the-spot user input, and Ecotrust was able to resolve system bugs, expand FoodHub's specialty crop taxonomy, and develop new functionalities as needed. At this time, they also modified the marketplace section, changed the way newcomers interact with the site, and added a blog to communicate more effectively with users and interested parties alike. The first quarter of project work set the stage for the remainder of the project, with an ongoing iterative development and evaluation process that closely involved FoodHub members every step of the way.

The full public launch of FoodHub was held in February, 2010, with a ceremonial ribbon-cutting by USDA Deputy Undersecretary Ann Wright at an event attended by over 120 Northwest food and agricultural colleagues. We debuted FoodHub Version 2.0 in September, 2010, at the Oregon Restaurant and Lodging Association annual meeting in Bend, Oregon. Version 2.0 incorporated improvements and new developments reflecting user analysis and feedback gathered over the first eight months of the site's public use. In July, 2011, after additional user feedback and technical development, Ecotrust launched FoodHub Version 3.0 which included a wide range of improved and new features, along with a new "Associate" member category to complement existing buyer and seller memberships. (Technical development for each version of FoodHub is detailed more fully below under "Goals and Outcomes Achieved".)

WSDA's early investment has been critical in making FoodHub the effective, vibrant, thriving online marketplace it is today. **To date, there are 735 Oregon and Washington specialty crop producers registered as FoodHub members, as well as 1144 Oregon and Washington food buyers registered.** While these figures are lower than Ecotrust's original goals for the two-year project period, specialty crop user members show strong growth. The 2010 member survey found 260 Specialty crop producers in Oregon and Washington were registered FoodHub members, a number which has nearly tripled. Registered members who are specialty crop buyers have more than tripled, from 338 as of the 2010 annual survey.

These figures likely under-represent the participation of specialty crop producers and buyers in the FoodHub system. For the purposes of this grant, Ecotrust has consistently only counted specialty crop producers as those members who register as "farmers", and would thus not include a diversified dairy or a ranch producing and marketing specialty crops in addition to dairy and livestock. Today FoodHub boasts nearly 3,000 members, the vast majority of which are buying or selling specialty crops in some form.

Ecotrust is fortunate in that there are many other deeply vested partners who share a sense of responsibility for and ownership over FoodHub's success. FoodHub was created in consultation and collaboration with colleagues throughout the region, including producer groups, non-profit organizations, government agencies, and private businesses, each of whom commented on early design concepts or today work in partnership with them to disseminate the resource to their constituencies. These colleagues and allies across Washington, Oregon, and the greater region continue to help them promote FoodHub as a key tool for strengthening connections between regional food buyers and sellers.

Adding a membership category for Associate members also served to engage a whole host of project partners, including universities (e.g. Washington State University Rural Community Vitality Team), trade associations (e.g. Northwest Food Processors Association), commodity commissions (e.g. Pear Bureau Northwest), advocacy organizations (e.g. Washington Sustainable Food & Farming Network's Fresh Food in Schools project), and many others. Partners participate at various levels, with some simply joining FoodHub to take advantage of its many features, while others are deeply engaged in ensuring FoodHub's success. As but a few examples of the later, SYSCO Food Services supported the growth of FoodHub by initially underwriting memberships in the tool for Oregon and Washington producers, while Rotary First Harvest has supported FoodHub's growth by encouraging food banks and emergency food assistance organizations to use FoodHub as a tool to procure fresh fruits and vegetables.

GOALS AND OUTCOMES ACHIEVED

The project activities fell into three main categories: **technical development** (including the creation, testing, and release of new features); **outreach and promotion** (including training, member support, and marketing); and **monitoring and evaluation** (including ongoing assessment of user feedback and site functionality, research and implementation of best practices, and related adjustment of the project plan). Each of these three areas is addressed in detail below.

Technical development

The grant period encompassed significant and far-reaching developments to FoodHub, from the beta-launch through three official Version launches. Each launch incorporated additional changes, upgrades, and refinements to FoodHub based on member feedback and user testing.

Beta-launch— November 1, 2009

- **Basic member profiles:** specialty crop buyers and sellers have a direct line of sight to one another through member profiles that include business details and contact information;

certifications held; products available for purchase; and pick-up, delivery and distribution information.

- **Marketplace:** with over 1,000 items in its taxonomy, FoodHub can accommodate food producers and food buyers of every scale and production type.
- **User feedback:** embedded site mechanisms encourage users to provide on-the-spot suggestions for added features or site improvements.
- **Ongoing usability testing:** although preliminary testing with initial users is complete, FoodHub plans on-going usability testing to ensure that the tool provides the features our users most need to meet their business objectives.

Version 1.0— officially launched February 1, 2010

- **Improved site functionality:** as expected, numerous system bugs became evident once FoodHub was made available publicly, and these were resolved on a case-by-case basis.
- **Expanded taxonomy:** based on the input of producers and buyers, FoodHub's taxonomy included even more Washington and Oregon specialty crops.
- **Marketplace:** new functionalities include listing Idaho markets and distributors to accommodate producers in Eastern Washington, and also allow producers to list which farmers markets they attend.
- **Multi-functional profiles:** new profile features allow users to act as both buyers and sellers so that members can maximize their use of FoodHub (e.g. bakery members who buy raw ingredients and sell finished products).
- **FoodHub blog:** through regular blogposts, the FoodHub team is able to communicate more effectively with users and interested parties alike.

Version 2.0— launched September 20, 2010

- **Marketplace:** the site's taxonomy more than doubled to over 2,000 products, meaning more regionally grown and produced food products, including specialty crops, were available at the click of a button.
- **Heightened matchmaking:** we expanded the range of customized searches, from general product descriptions to highly specific requests, and suggested potential matches to members upon login.
- **Site orientation:** an improved, more approachable homepage interface and navigation tools were introduced to do a better job of orienting new members to the site.
- **Online training:** a welcome video was added to provide new members or returning users with an overview of the system's features and quick coaching on how to get started and make the most of FoodHub's matchmaking functions.

Version 2.0 upgrade— released at FoodHub's one-year anniversary

- **New member category:** creation of Associate membership to engage commodity commissions, trade associations, logistics providers and many other associates who support specialty crop producers.
- **Free membership option:** the \$100 annual fee was removed for basic membership for buyers, sellers and associates.
- **Fresh Sheets:** creation of a weekly bulletin, differentiated for buyers and sellers, emailed directly to members and also posted on the FoodHub blog. Fresh Sheets promote select specialty crop items that are either for sale or are wanted by buyers, and also feature product alerts, marketplace updates, and a weekly tip to help members use FoodHub most effectively.
- **Knowledge Base:** creation of a robust resource section where FoodHub members can access information designed to support sales of specialty crop products.

Version 3.0— launched July 12, 2011

- **Marketplace:** improved filter functionality to allow FoodHub members to sort byproduct type, distance or custom criteria with a single click.
- **Advanced Search Functionality:** search tools that allow users to search multiple variables at once and make it a snap to find local producers.
- **Training and member support:** new Step-by-Step Tutorial Videos are now available online 24-7, and a Help Desk staffed with live agents 8am-6pm weekdays, to help members take full advantage of FoodHub’s cutting-edge technology to build their businesses.
- **Improved Knowledge Base:** FoodHub’s online library of tools, resources and thought leadership on local food sourcing and supply chain challenges and solutions became available to the public.
- **Membership options:** to accommodate the needs of a wide range of users, three levels of membership are offered. “FastStart” membership provides a basic user profile and access to the Member Directory and Marketplace free of charge. For greater visibility and more features, members can upgrade to a monthly “Advantage” or annual “All-Access” account that allows them to enhance their member profiles and marketing strategies.
- **Marketing options:** creation of additional promotion opportunities for FoodHub members such as paid advertising, sponsored content, paid search placements, and weekly featured listings.

Outreach and promotion

Throughout the project period, the FoodHub team has worked to develop and continually improve their outreach and promotion efforts. These efforts include on-site presentations and training, online tools, video tutorials, phone support, participation in conferences and tradeshow, networking events such as Farm to Fork, individualized training in collaboration with Ecotrust’s Farm to School program, direct mail, and strategic advertising and promotional placement. Outreach and promotion activities included:

- **Face-to-face outreach:** During the project period, the FoodHub team has conducted onsite presentations and trainings in settings urban and rural, small and large, for buyers and sellers, throughout Washington and Oregon.
- **Partner engagement:** Ecotrust has consistently worked with partner organizations serving specialty crop producers and buyers to mobilize their members and stakeholders to participate in FoodHub. These diverse entities from the region’s food and farming community include trade associations, distributors such as Food Services of America (FSA), farmers’ markets, and government agencies.
- **Conferences and events:** The FoodHub team has attended a wide range of conferences, tradeshow, and related events to raise awareness of FoodHub as a tool for regional food system stakeholders from farmers and agricultural agencies to supermarkets, food banks and schools.
- **Online tools:** Ecotrust has developed a strong set of online outreach tools that include e-newsletters, emailed Fresh Sheets, the FoodHub blog, and direct email contact with FoodHub users.
- **Social Media:** FoodHub maintains an active Facebook page (with 2046 followers), as well as a Twitter account (with 1379 followers).
- **Individual support:** The FoodHub Help Desk is staffed by core members of the FoodHub team Monday-Friday, 8 a.m.-6 p.m., accessible by phone at (503) 467-0816 or email at meet@foodhub.org.
- **Video tutorials:** Ecotrust created a series of accessible, engaging videos to assist members in getting oriented and using FoodHub. Current videos include: “An Orientation to FoodHub”, “Getting Started on FoodHub”, and “Filling Out Your FoodHub Profile”.
- **Incentive programs:** Ecotrust has developed a number of incentive programs to encourage member referrals, membership upgrades, and paid promotional opportunities.
- **Direct Mail:** In order to address specifically identified issues in the public perception of FoodHub, Ecotrust designed direct mail campaigns targeted to food buyers and specialty crop producers in the region.

- **Earned media:** Media interest in FoodHub has been strong from its incipient stages, and continues to be robust since the launch of Version 3.0 in July. Samples of media coverage have been submitted with Ecotrust’s quarterly reports, and are also available at <http://food-hub.org/pages/press>.
- **Success stories:** FoodHub’s most effective tool in outreach and promotion is the personal success stories of current users. Ecotrust continually gathers and documents stories from FoodHub users about the connections made through the site, with a particular focus on capturing both sides of the story in the words of specialty crop producers and regional buyers. These stories and photographs are featured prominently on the site on both buyer and seller pages.

During the project period, two exciting opportunities arose which Ecotrust did not anticipate, and which helped to raise the profile of FoodHub while underlining the importance of rural development, regional food systems, and specialty crops. In 2010, Food & Farms Vice President Deborah Kane presented FoodHub at the invite-only National Nutrition Summit in Washington DC hosted by the Department of Health and Human Services and USDA, “Changing the Food Environment: Making it Happen.” This summit gathered a wide range of food system leaders and stakeholders to share information about ways to improve access to healthy foods, and highlighted a number of federally-supported initiatives that support and promote a healthy food environment. Deborah presented on FoodHub as part of the “Know Your Farmer, Know Your Food” initiative. The USDA briefing was well received and included representatives from the “Food Hubs” team at USDA. Deborah also hosted FoodHub information sessions on Capitol Hill. Deborah’s presentations at the Nutrition Summit and on Capitol Hill during this visit were purely for informational purposes, and were not part of any lobbying activities. Ecotrust is very much aware that lobbying would be a restricted use of federal grant funding, and no SCBGP funds were used towards lobbying activities at any point. In July, 2011, Deborah was again invited to Washington to share her work on FoodHub in a roundtable discussion hosted by the recently-established White House Rural Council.

To increase their capacity in conducting effective marketing outreach, Ecotrust invested in the customer relationship management tool, Salesforce, to be used for recruiting and managing FoodHub users. Key staff received intensive training in Salesforce, following which they worked to establish a basic system and field two successful Salesforce “test” campaigns. Salesforce will allow the FoodHub team to fine tune acquisition and engagement campaigns to maximize effective communication and marketing.

Monitoring and Evaluation

As noted above in Section 4, user feedback has been an integral part of the FoodHub development plan from the very first stages. Because FoodHub’s success will be based upon its utility and responsiveness to user needs, Ecotrust places particular emphasis on continuously improving the tool in direct response to user feedback gathered. Primary user evaluation channels include periodic formal user testing of features, focus group sessions with a range of users and stakeholders, site-based feedback mechanisms, and an annual member survey. In addition, the FoodHub team conducts weekly monitoring of site usage patterns and ongoing monitoring of site functionality.

User-testing groups and focus groups with specialty crop producers and buyers in general yielded helpful feedback regarding ways in which FoodHub could deepen relationships with specialty crop producers and buyers. The “feedback” button that prominently appears throughout the site, automatically creating an email to FoodHub administrators for on-the-spot user feedback, has been an invaluable source of user input. Apart from issues related to the features, FoodHub members consistently provide feedback related to the site’s fruit and vegetable taxonomy, helping us update and improve the way in which information regarding specialty crops is presented on the site. The annual member survey provides an important means to evaluate FoodHub’s effectiveness overall, and to gather feedback about its usefulness in growing the specialty crop market.

Weekly site monitoring allows Ecotrust to identify usage patterns and trends and address engagement issues specifically through a variety of channels, provide key data used to develop outreach efforts and educational content. Where they observe that features are being underutilized, they create online “How To” tutorials, provide tips in e-newsletters, create phone support scripts, and develop training protocols for use during in-person member trainings.

Achieving self sufficiency for FoodHub is a long term goal. During the course of this granting period Ecotrust took steps to ensure FoodHub’s long term financial viability by modifying the business model and adopted a “freemium” model, removing the original \$100 membership fee that created a barrier to entry for some specialty crop buyers and sellers, and added new fee-based features described above. This change represents the first step toward fine tuning FoodHub’s business model so that over time the resource is self sufficient. In the future, they intend to build upon the successful model created in the Northwest and open FoodHub membership up to a national audience. This next step allows Ecotrust to meet financial goals (drawing from a much larger potential customer base) as well as programmatic goals related to promoting specialty crops to the widest array of food buyers possible.

The overall goal of FoodHub is to provide an online directory and marketplace that makes it easy and efficient for buyers and sellers of regional food to find one another, share their stories and conduct business. In particular, FoodHub was designed to support the needs of specialty crop producers in Washington and Oregon, and enhance the market opportunities for these producers. During the project period, FoodHub has proven itself to be a powerful tool in supporting specialty crop markets within a thriving regional food system. FoodHub gathers food producers, professional food buyers, and the associations and suppliers that serve them both, in one dynamic marketplace and interactive directory.

As of this report, FoodHub boasts nearly 2,900 members, across four different membership categories. Buyer and seller members are balanced at 39% of overall membership, while associate members make up 19% of members and distributors make up 2%. But FoodHub’s success can be measured in more than simply membership stats. This is readily apparent in the stories we hear from FoodHub users. Thanks to FoodHub, Sound Food in Bainbridge Island, Washington helped a retailer on the island source USDA-certified local pork from *Flying Dog Farm* in nearby Grapeview. Because of FoodHub, *Our Family Farm* in Eugene, Oregon now supplies pastured chicken to the 350 families who do their food shopping through buying club *Know Thy Food* in Portland, Oregon. And the Wahluke School District in Mattawa, Washington connected to *Bella Terra Gardens* in Zillah to provide regular deliveries of tomatoes and cucumbers for the school’s salad bar this year.

Connections such as these happen on a regular basis. And in addition to delivering immediate value to Oregon and Washington specialty crop producers, FoodHub received national acclaim throughout this grant period, with Fast Company magazine naming FoodHub one of the “Ten Most Innovative Food Companies” while Treehugger.com selected FoodHub as “Best Food Business Innovation”. We Are Not Ants, a book and website (wearenotants.org) devoted to highlighting promising social innovations, included FoodHub in its online directory of projects “that suggest more intelligent ways of doing things”. Most recently, Mother’sNewsNetwork included FoodHub in its Top 10 List of great tools for getting better food into schools.

Ecotrust has made measurable and significant progress towards the four outcomes defined in their project proposal. Each of these four original outcomes are included below, along with an update detailing the present status of progress towards each.

- **Outcome 1:** *Provide specialty crop producers a simple way to provide general information about their business and market themselves, their stories, and their products (GOAL). No such tool*

currently exists (BENCHMARK). At least 700 OR and WA specialty crop producers will have FoodHub user records in Year 1 and at least 1,400 OR and WA specialty crop producers will have FoodHub user records in Year 2 (TARGET and PERFORMANCE MEASURE). In addition, 85% of specialty crop producers surveyed will report satisfaction with the tool (TARGET) as measured by an annual FoodHub user survey (PERFORMANCE MEASURE).

Update: FoodHub has been recognized by specialty crop producers throughout Washington and Oregon as an effective, user-friendly way to provide general information about their business and to market their products within the region. Feedback on FoodHub has been overwhelmingly positive, with specialty crop producers and buyers confirming that FoodHub provides a vital service. In year one, 64% of those surveyed reported satisfaction with FoodHub as a tool (measured by members' willingness to recommend FoodHub to a friend). As of the November 2011 annual member satisfaction survey, 70% of those surveyed reported a willingness to recommend FoodHub to a friend.

While this is lower than the goal of 85%, it should be noted that "willingness to recommend" is not the same thing as satisfaction with the tool. Ultimately, Ecotrust selected willingness to recommend as a key metric to measure over time because it represents both baseline satisfaction with the tool *plus* a level of enthusiasm necessary to recommend the tool to another person. Thus, they are quite satisfied with knowing that 70% of those surveyed indicated a willingness to recommend FoodHub to a friend. They will continue to monitor user satisfaction through ongoing feedback, annual surveys, and other means, and expect that user satisfaction will steadily increase given their dedication to improving the tool in response to member feedback. Both the first and second annual member surveys found that the feature set in FoodHub was relevant to specialty crop producers' needs, with more than 50% of members in both years indicating high levels of interest in the directory listings, search, message center, and marketplace features.

As mentioned above, Ecotrust currently has 735 Oregon and Washington specialty crop producers registered. While these figures are lower than the original goals for the two-year project period, specialty crop user members show strong growth. The 2010 member survey found 260 Specialty crop producers in Oregon and Washington were registered FoodHub members, a number which has nearly tripled. Registered members who are specialty crop buyers have more than tripled, from 338 as of the 2010 annual survey. In addition, these figures likely under-represent the participation of specialty crop producers and buyers in the FoodHub system. For the purposes of this grant, Ecotrust has consistently only counted specialty crop producers as those members who register as "farmers", and would thus not include a diversified dairy or a ranch producing and marketing specialty crops in addition to dairy and livestock. Today FoodHub boasts nearly 3,000 members, the vast majority of which are buying or selling specialty crops in some form.

- **Outcome 2:** *Provide specialty crop buyers a simple way to provide general information about their business, access information about specialty crop producers, and order specialty crops based on specific requirements (e.g. certification, proximity, distribution model, and price) (GOAL). No such tool currently exists (BENCHMARK). At least 750 OR and WA food buyers will use FoodHub to buy from specialty crop producers in Year 1 and at least 1,500 OR and WA food buyers will use FoodHub to buy from specialty crop producers in Year 2 (TARGET) as measured by data tracked in FoodHub user records (PERFORMANCE MEASURE).*

Update: Like producers, specialty crop buyers in Washington and Oregon confirm that FoodHub is a simple, effective and convenient way to provide general information about their businesses, access information about specialty crop producers, and identify sources for specialty crops based on their specific requirements. As of this report, 1144 specialty crop buyers are conducting these activities via FoodHub. While this is lower than the target of 1,500 specialty crop buyers, Ecotrust believes that

FoodHub is poised to meet and exceed this target. Just in the 6 weeks since Ecotrust submitted their final quarterly report on October 28th, the number of specialty crop buyers registered on FoodHub has increased by 45 members.

- **Outcome 3:** *Create new market opportunities for specialty crop producers by increasing the number and types of food buyers purchasing their products (GOAL). At the end of Year 1, we estimate that a minimum of 35% of participating producers surveyed will indicate increased numbers and/or types of buyers with whom they are doing business (TARGET) as compared to levels prior to FoodHub participation (BENCHMARK). At the end of Year 2, we estimate that a minimum of 60% of participating producers surveyed will indicate increased numbers and/or types of buyers with whom they are doing business (TARGET) as compared to levels prior to FoodHub participation (BENCHMARK). Performance will be measured through producer self-reported data in FoodHub user record data fields and/or on annual surveys (PERFORMANCE MEASURE).*

Update: Both formal evaluation data and anecdotal information confirm that FoodHub is indeed an effective and highly usable tool for increasing the number and types of food buyers purchasing specialty crop producers' products. Throughout their quarterly reports, Ecotrust has included quotes from FoodHub members on both sides of the marketplace that demonstrate individual success stories. These featured cases are backed up by two years of quantitative data from the FoodHub annual member survey. As of this report:

- 60% of FoodHub producers report making 2-4 new connections via FoodHub, while 20% report making 5-9 new connections and 3% report making 10+ new connections.
- 20% of FoodHub specialty crop producers report making at least one sale to a FoodHub connection, with the dollar value of such sales ranging from \$250 - \$20,000.

Types of specialty crop buyers who are registered FoodHub members represent a wide range, including grocers, chefs, caterers, schools and school districts, universities and hospitals.

- **Outcome 4:** *Increase specialty crop producers' total volume of sales or dollar value of sales (GOAL). At the end of Year 2, we estimate that a minimum of 40% of participating producers surveyed will indicate increased volume of sales or dollar value of sales (TARGET) as compared to levels prior to FoodHub participation (BENCHMARK). Performance will be measured through producer self-reported data in FoodHub data fields and/or on annual surveys (PERFORMANCE MEASURE).*

Update: While FoodHub sellers, as noted above, reported making as many as 2-10+ new connections on FoodHub, Ecotrust has less reliable data on the total dollar value of sales attributable to these connections because FoodHub does not track nor facilitate the actual transaction. Thus, to ascertain the degree to which FoodHub contributed to increased purchases of local product from the regional food economy, Ecotrust ended up relying on self reported data from *buyers*.

- 47% of FoodHub buyers report increases in the variety of local foods purchased.
- 41% of FoodHub buyers surveyed report increases in the overall percentage of their food costs dedicated to local food.
- 50% of FoodHub buyers report making 2-4 new connections via FoodHub, while 12% report making 5-9 new connections and 2% report making 10+ new connections.

In survey results, individual buyers offer testimony to the wide variety of successful connections and business relationship established through FoodHub. One buyer found the tool so effective that it became part of the standard sourcing plan: "I am going to assign a member of my staff to be my 'Foodhubber' and give her a monthly budget that she can (and must) spend." Another buyer spoke to the tool's facilitation of working directly with producers to farm specific crops, to the benefit of both: "I joined Food Hub in February 2011 to meet local farmers that wanted to grow peppers. I have indeed met many,

and have done business with 3, including my main supplier: Barbee Orchards/Bella Terra Gardens of Zillah Washington. We selected seed together back in February and were in communication all spring, summer, and fall as the plants grew and produced over 5000 lbs of peppers; of which I bought over 3000 lbs!" A third noted FoodHub's utility in finding regional sources for crops not available locally: "I just discovered FoodHub this spring and it was very useful for us finding cabbage from Washington before it was ready in Thurston County."

BENEFICIARIES

Reviewing the project period, it is plain that specialty crop producers of all kinds in Washington and Oregon have benefited from the existence of FoodHub, as well as an immense range of specialty crop buyers. Ecotrust has found FoodHub to be particularly relevant to school food services directors who are new entrants to farm to school programming, a movement which is gathering momentum throughout the region. Additionally FoodHub serves area distributors seeking to expand their local offerings. And finally, with the addition of the Associate membership, FoodHub has proven itself to be a valuable resource for farmers markets, commodity commissions, trade association, non-governmental organizations, universities, and others who support regional food trade in various ways. From their annual members survey, Ecotrust heard from Associate members, "This site is a great networking resource for my services" and "I suggest to all my clients to become FoodHub members."

LESSONS LEARNED

A key lesson from this project is that face to face interactions remain a critical component when launching a new resource or tool.

Members received weekly email communications and encouragements from FoodHub and there was notable traction throughout the region with the site routinely in the popular and trade press. In addition, FoodHub's site architecture is generally perceived to be user friendly and intuitive. Yet time and again Ecotrust discovered that face-to-face trainings, or personal phone calls, were the most effective strategy for engaging members. There are so many distinct features within FoodHub that in-person trainings and demos, or one-on-one conversations, were the most effective means for educating members about how to maximize their use of and success with the tool. This presented challenges as FoodHub was attempting to cover two entire states with a very small staff. Thus, in addition to in person trainings they also created online video tutorials that could be more widely disseminated.

Similarly, face to face networking for members was equally effective in creating business connections. In the fall of 2011 Ecotrust hosted a wholesale-only open air market for FoodHub members and found that the face to face interactions reinforced online connections that had been made on the site in a very positive way. Technology can support real human relationships, but it will never replace them. This was a theme revisited over and over throughout the project period.

When FoodHub first launched Ecotrust imagined it would be used specifically by food buyers and sellers to connect and conduct business related to food products. Over time, it became clear that the platform could support connections of many kinds and for many different types of members. In recognition of this, Ecotrust reoriented the membership to include not just buyers and sellers, but also associate members such as farmers' market managers, university personnel, government agencies, advocate organizations, service providers, commodity commissions and the like. Similarly, they encouraged information sharing and points of connection that went well beyond food. For example, the site is now increasingly being used to coordinate logistics and transport opportunities with members posting information about routes they run, or space availability on refrigerated trucks. Ecotrust is also very pleased to see the emergency food assistance community increasingly using FoodHub to solicit donations of fresh fruits and vegetables, an outcome they didn't foresee in the beginning.

FoodHub was not able to recruit the number of specialty crop buyers and sellers originally projected. In hindsight, the original \$100 membership fee was a barrier to entry that slowed widespread adoption. W Ecotrust has since addressed the issue by changing the business model to accommodate free memberships, but the perception that FoodHub costs money to join lingers. This early misstep is demonstrative of the healthy tension between delivering immediate results and taking steps toward self-sufficiency. It also represents an original lack of familiarity and expertise with successful internet business models. FoodHub is a classic example of a social venture enterprise; we were both mission driven and business oriented. For others attempting online efforts in the future, early inclusion of advisers familiar with successful tech-oriented business models and marketing approaches would likely be useful.

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ADDITIONAL INFORMATION

In their proposal, Ecotrust outlined plans to leverage WSDA Specialty Crop funds with a total of \$375,000 in funding from a range of sources including Foundations, Oregon Department of Agriculture, and program income. Matching fund totals for the project equal \$392,113. Program income equals \$100,000. In year one, income was generated through membership assessments and member fees. In the second year, income was derived from paid advertising, membership upgrades and sponsored search terms—all revenue streams which will contribute to FoodHub’s long term self-sustainability.

FoodHub receives continued investment from a wide range of partners, including federal and state funders, foundations, and individual donors. In 2011 they received a third SCBGP grant from ODA and a grant from USDA’s RBEG program to build on FoodHub’s early success by expanding the FoodHub community of practice to include “Associate” members. Originally, FoodHub membership had only been open to individual buyers and sellers. Farmers’ market managers, commodity commissions, trade associations, advocacy organizations, logistics providers, academic institutions, government agencies and many other service providers were left out of the conversation. The current priorities in developing FoodHub are to continue improving features used by specialty crop producers and buyers, while also engaging a tremendous range of Associate members so that they can better support and promote the development of specialty crop markets.

Washington State Horticultural Association
GRAS²P: Growers Response to Agriculture, Safe, and Sustainable Practices

PROJECT SUMMARY

Food safety audits are already a way of business life for tree fruit warehouses and marketing groups; it is not uncommon for a single entity to be having 3-8 audits per year. The expense is huge and the cost is paid through the sale price of fruit produced by growers. Retail pressure is building to extend these food safety audits to the growing site as well as to implement sustainability audits.

GRAS²P was intended to be a proactive, shared-cost approach to prepare growers for third party audits as well as to support documentation of and continuous improvement in safe and sustainable practices used by growers to produce apples, cherries, pears, and stone fruits. GRAS²P was designed to address food safety, education, and environmental concerns connected to the Washington State tree fruit industry.

Specific project objectives were to 1) assist a minimum of 350 Washington tree fruit farms become prepared for third-party food safety audits; 2) provide tree fruit growers with educational opportunities to increase their knowledge of and improve their sustainable practices in the areas of soil and water management; 3) identify/modify a grower-friendly database system facilitating organization and storage of on-farm documentation regarding safe and sustainable practices used in the orchard; 4) develop bilingual, multimedia educational materials to support both hands-on grower education and to communicate to consumers the responsible and sustainable practices applied within the tree fruit industry; and 5) extend the hard copy version of the GRAS²P workbook and materials to a web-based version usable via computer and/or PDA.

All objectives were met, with the exception of objective 3. During the project, it was determined that conducting 100 additional pre-audits would be a better use of the funds budgeted for software modification/development.

PROJECT APPROACH

The following activities were conducted over the course of the project:

- Conducted GRAS²P workshops and educational trainings on food safety annually at the WSHA annual convention.
- Trained 10 GRAS²P pre-auditors per the Global Gap Internal Inspector requirements.
- Created and made available “GRAS²P Worker Orientation and Food Safety” video.
- Developed educational materials, including GRAS²P posters and a live feed (GoToMeeting) of a GRAS²P training that is also on the GRAS²P website.
- Created and made available over 500 GRAS²P guidance manuals for Washington State growers.
- Pre-audited 585 growers.
- Provided coaches and growers with technical support and training throughout this year with classes, manuals and on-site preparations for their audits.
- Conducted 5 GRAS²P training opportunities.
- Made available a web-based training guide (on the GRAS²P website) for growers to access and utilize when necessary.
- Annually published Washington State Hort Proceedings book (available online) on topics that include educational guidance such as crops/soil/water management, auditing and food safety.
- Developed curricula to teach a mass “Training for Growers” to address Global Gap, food safety, health and hygiene, water and soil management and many other relevant topics to food safety.
- Prepared templates for orchard signage needed in order to comply with food safety audits.

- Provided access to GRAS²P materials and templates to growers and coaches in an electronic format that is compatible with the web and/or PDA (personal digital assistance) devices. This format was also extremely useful for GRAS²P specialists as they conducted pre-audits and worked with the growers to identify any necessary next steps.

Project partners included WSU Cooperative Extension, the Washington Tree Fruit Research Commission, WSU Tree Fruit Research and Extension Center, each of who played a large role by contributing to WSHA's food safety sessions and annual GRAS²P training seminars. NCSI Americas conducted pre-audits, and AJL and M&M Productions was contracted to create the highly successful GRAS²P video to help growers train their workers.

GOALS AND OUTCOMES ACHIEVED

WSHA contracted with the international certifying body NCSI Americas to perform pre-audits. Although 350 pre-audits were targeted as the original Expected Measurable Outcome, a total of 585 pre-audits were conducted. This increase was made possible as a result of the following two circumstances:

- 1) In early 2011, WSHA requested and received approval to shift funds away from planned software modification/development and instead utilize those funds to conduct 100 additional pre-audits, bringing the new target to 450 pre-audits.
- 2) In the summer of 2012, WSDA approved WSHA to utilize funding that remained unspent by other WSDA SCBGP FY09 projects. These remaining funds allowed WSHA to conduct an additional 135 pre-audits, bringing the total to 585.

Although not one of the original Expected Measurable Outcomes, WSHA also measured the number of warehouses/growers that participated in GRAS²P who went on to become certified. The numbers by warehouse include: McDougall (130 pre-audits), Blue Star (128), Blue Bird (200), Chelan Fruit (93) and Apple House (34). 100% of growers who received pre-audits through this project have become GlobalGAP certified.

BENEFICIARIES

Direct beneficiaries include the 585 farms that participated in this program and who have successfully passed a third party food safety audit. Many others in the tree fruit industry have also benefited as a result of the multiple trainings, outreach events, and educational materials provided through GRAS²P. Spanish speakers in the industry also benefited, as many of the materials were translated into Spanish.

In addition, the 585 participating growers received the direct economic value of the pre-audit's costs, all of which was covered through the grant. However, the economic impact as a result is much greater. All have since been deemed in compliance with required 'good agricultural practices.' Compliance means fruit from these orchards can be shipped to all retailers requiring GAP certification. In the broadest sense this means that this project has protected a significant portion of the \$2.4 Billion farm-gate value of crops that are shipped annually from Washington State. That translates to over \$6 Billion in economic activity statewide as 30% of Washington's production is exported, generating over \$800 Million in sales revenue. Domestically, Washington is the leading fresh apple producing state and 98% of what is grown in Washington is consumed outside of the state. This also means that 98% of the revenue comes from outside of Washington; however this revenue then stays in Washington where the growers/packers/marketers are locally owned and operated. Microsoft and Boeing cannot make such a claim. Hence, the overall economic impact to the state is enormous. This grant – while relatively small in overall dollar volume – is huge in its economic impact to the state and to the growers/warehouses who are directly impacted.

LESSONS LEARNED

This project was originally planned to last for one year, however, there was not a lot of interest the first year and less than 60 pre-audits were conducted. It wasn't until the large retailer WalMart came out with their letter to growers stating that they needed to comply "with on-farm" food safety audits by July 30, 2012. A month after this letter, President Obama signed the Food Safety Modernization Act which initiated a huge rush of Washington State growers wanting help with their food safety programs and needing training. Because the GRAS2P project was in place, WSHA was ready to start training growers to become GAP certified. The shelf-ready manual was a quick and easy way for growers to understand the compliance criteria of Global GAP. Finally, the funds that were available from the grant made it very appealing for growers/warehouses to seek the guidance and training from GRAS2P.

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ADDITIONAL INFORMATION

Total match received during the course of the project totaled \$143,940.
GRAS2P materials and resources can be found at: www.gras2p.com.

Washington State University

Cut Flowers: Developing Sustainable Insect Management and Marketing Strategies

PROJECT SUMMARY

The National Agricultural Statistics Survey consistently ranks Washington State in the top five cut flower producing states. However these statistics primarily represent a relatively small number of large, commercial bulb producers, while a higher number of small-scale cut flower producers, including the Hmongs, underrepresented statistically, serve many of the 160 farmers markets throughout the state, as well as locally run, progressive grocery stores and florists, tourist venues such as Pike Place Market in Seattle, and other direct marketing channels like roadside stands, U-pick farms, and Community Supported Agriculture (CSA). The objective of this grant was to increase the profitability of Washington State's underserved small-scale cut flower farms, by providing sustainable pest management techniques and by developing marketing strategies to improve their profit margins.

At the beginning of this project, there was a lack of profitable market channels and understanding about the many marketing challenges facing small-scale cut flower growers in Washington State. Over the term of the grant, a wholesale growers market has been developed in Seattle by a group of small-scale cut flower growers. This grant influenced development of the wholesale market and provided encouragement for Washington State's specialty cut flower growers to write and receive their own specialty crop block grant, awarded in 2012. For Washington cut flower growers who cannot participate in the wholesale market due to geography, alternative business goals, or differences in product attributes, many other market opportunities and strategies were identified. This project aimed to address marketing challenges common to both Hmong and traditional growers, as well as challenges specific to each group, resulting in a strengthened industry.

The Hmong grow a more traditional range of cut flowers and primarily target farmers markets, which offer potential for volume sales with relatively low overhead cost of selling. Through this project, Hmong flower growers have benefited from opportunities to learn new sustainable pest management techniques and gain awareness of new selections and improved vector management through the Grower's School, on-farm visitations, and experimental demonstrations and consultation. Harvest data collected from Hmong farms and a bouquet pricing study conducted by this grant documented the price level for cut flowers at farmers markets where Hmong sell, establishing a basis for Hmong crop valuation and comparison with more profitable alternative sales channels in the future.

Prior to the wholesale growers market, Washington State's cut flower industry was associated with the Hmongs and large commercial bulb growers. Following development of the wholesale market, the industry has developed a more complete identity that includes traditional small-scale specialty cut flower growers, Hmong flower growers, and large commercial bulb growers. The wholesale growers market continues to strengthen the cut flower industry in Washington State through statewide grower education, networking, and promotion, while rapidly capitalizing on increasing wholesale buyer interest in high quality locally grown cut flowers. The growers market also plays a prominent role nationally in promotional and educational efforts on behalf of specialty cut flower growers in the United States. In the course of this grant, Washington's small-scale growers have gone from obscure and playing a minor role in Washington's cut flower industry, to national leaders!

Interest in small-scale production of cut flowers is growing but market status at the start of the project was limited to the state's 160 farmers markets, limited direct sales to florists, unprofitable sales to wholesalers, other small volume, direct-marketing options. The Hmong and other small-scale cut flower growers, comprising a stratified specialty cut flower industry, were competing for the same limited markets in some regions of the state. Differences in culturally based production methods, pest management philosophy, and price-setting strategies further promoted schism and hindered industry growth. There

was a need to identify additional market channel opportunities, compatible with the ideologies and resources of these two groups in order to support further industry growth and success. Given the current consumer interest in locally-produced products, there is tremendous potential for small-scale cut flowers to capitalize on this trend by marketing their “locally grown” flowers to both businesses and individual customers.

PROJECT APPROACH

Entomology

Become familiar with the small-scale cut flower grower industry and determine their most critical pest/damage issues. Conduct interviews to understand the current cut flower grower knowledge of damage/causative insect.

The entomology team conducted multiple interviews on-farm (15 with both Hmong and traditional flower growers) and a written pest survey at the 2011 cut flower grower’s school. Results (Table 1) indicated that Washington state specialty cut flower growers believed in sustainable/organic production methods for pest management of cut flowers. Only two growers indicated they used pesticides and only one of those considered themselves a conventional grower, while the other practiced IPM. The majority of Hmong and traditional growers prefer sustainable methods of control. The Hmong are sustainable because either they believe in the philosophy of sustainability or they lack the ability to access proper pesticide training in their language and are reticent to ask for assistance outside the Hmong community. Traditional growers not restricted by language barriers are sustainable by choice and actively search out sustainable methods and supplemental training to incorporate into their farm management. Some of the strategies mentioned by the traditional growers include:

- Select cultivars that have few insect pests and avoid those that are prone to pest problems.
- Adopt a holistic approach to cut flower growing beginning with fertile soil and grow a diverse range of plants rather than large monocultures. Many of the traditional flower growers actively practice “farmscaping” techniques.

Only one grower interviewed was certified organic and recently had given up her certification. Others opt for a sustainable approach and indicate that the economic return for certified organic production is currently not enough incentive to endure the process of certification. Despite their preference for sustainable approaches, when asked, growers readily admitted they would use insecticides when appropriate. Of the seven survey respondents that provided information on cost of annual pest methods, only one indicated pest control inputs reached 10% of their annual budget, while all others indicated less than 5%. Four major cut flower pests were listed: aphids, slugs, thrips and spider mites. Eight minor pests were reported: earwigs and cutworms were mentioned multiple times (4 and 2 respectively) while others were mentioned once. Two of the minor pests listed were not cut flower pests, carrot rust fly and pear slug suggesting their farms were diversified and their income not totally dependent on cut flower production.

While the grower school survey respondents were relatively few in number, nevertheless they revealed prospective cut flower growers were not adequately trained in pest identification. The cut flower grower’s school included training in basic pest management of cut flowers. Survey results of these cut flower growers did not include lygus bug or western spotted cucumber beetle. In contrast with traditional non-Hmong cut flower growers, on-farm surveys including Hmong farms revealed western spotted cucumber beetle and Lygus to be serious pests. Large populations were observed on two Hmong farms compared with traditional cut flower growers farms. Conversations with them indicated they were aware that Western spotted cucumber beetle (WSCB) were more attracted to light colored flowers but had no knowledge of how to control them. Higher populations of WSCB on Hmong farms may be due to their tendency to intercrop flowers with vegetables, including cucurbits, which are highly attractive to cucumber beetles. Hmong and traditional cut flower growers indicated they were concerned about the

following pests: aphids, thrips, *Lygus* and western spotted cucumber beetles with additional occasional pests: grasshoppers, leafhoppers, weevils and spider mites. Aphids, thrips leafhoppers are plant virus vectors making control a priority particularly when plants such as dahlia are kept for longer than 1 season.

Table 1. Pest Survey, 2011 Grower's School

County	Acreage	Major pest	Host plant	Other pests	Pest management philosophy	Annual pest \$
Pierce	9		dahlia	earwigs	organic	2-3%
Skagit	100	aphids	cherries	voles	organic (certified?)	
Skagit	2	aphids slugs	dahlia	earwigs	sustainable	
Benton	6				conventional	
Island	10	slugs		earwig, pear slug		<\$150
King	7.5	aphids slugs	hellebores roses		cultural practices	
King	2	aphids, slugs	nasturtium bee balm lupine			not much
		aphids, slugs	Lupine thillictrum hosta		nothing	
King	18				Cultural practices	0
Thurston	3	Thrips aphids, spider mites		cutworms, cabbage looper, carrot rust fly	Organic (certified?)	
King	5	thrips aphids, slugs			cultural practices	<5%
King	5			deer	cultural practices	5-10%
Island	16	thrips	dahlia gladiola		Cultural practices (trap crops)	<1%
Whatcom	Park	thrips, aphids spider mites, slugs		Leafminer earwigs cutworms	IPM	
Clark		aphids, spider mites, slugs			organic	

Results of the insect pest surveys and interviews indicated that experienced commercial traditional growers had either adequate knowledge of pests and their control or how to access information. New growers lacked some of the basic information required for successful pest management in cut flower production but like the more experienced traditional growers, were more likely to seek help. The Hmongs could often identify the causative insect but had little knowledge of how to control them and were severely challenged when it came to knowledge of insecticides and their proper use. Language limitations particularly of the elder growers prevented them from the testing process required for obtaining a commercial applicators' license. Bee Cha explained the Hmongs lack a written language and require an interpreter for translating and training. It is not clear if they read English adequately to interpret insecticide labels but empty pesticide containers seen at their farms indicated they used "over-the-counter" insecticides. Comparison between active ingredients and insect pests observed at some of

their farms also indicated they lacked expertise in selecting effective insecticides and were unclear on distinction between conventional and organic approaches.

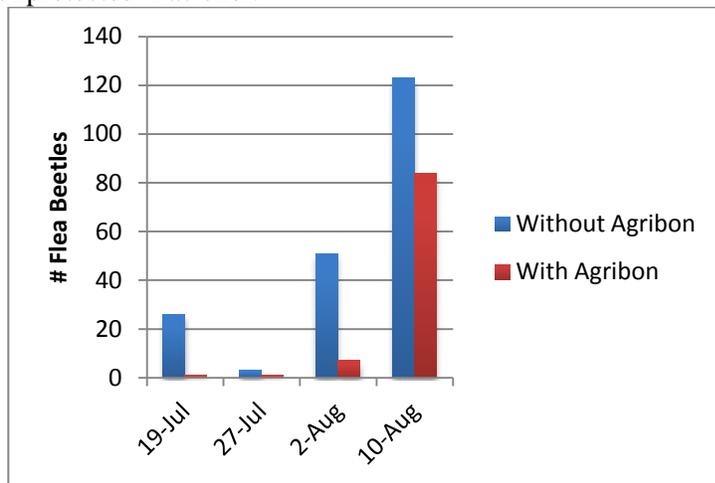
Hmong bouquets show more insect damage than those of traditional cut flowers; however the market venues for Hmong flowers are more tolerant of insect damage. While use of proper pesticides could improve quality of their cut flowers, it may not be economically advisable. Their improper selection of insecticides is a more serious issue. It may also indicate they lack the knowledge to properly handle, apply and store insecticides. Even “over-the-counter” insecticides are dangerous if improperly used. Observance of empty containers around their farm bodegas suggests they do not know how to properly dispose of insecticide containers. The Hmong community should be provided with safety training in proper selection and use of “over-the-counter” insecticides if they choose to use them, to prevent injury and insect resistance development. This training is beyond the scope of this grant but should be investigated.

Test the efficacy of vegetative architecture, row covers, reflective mulch and trap crops for control of virus vectors and flea beetles. Field test select row covers, reflective mulch, trap crops, vegetative architecture.

Row Covers

Small-scale cut flower growers, particularly the Hmong, often interplant with vegetables. This can result in a greater diversity of arthropods, both pests and beneficials. To address this we tested sustainable methods to prevent insect damage to vulnerable vegetables, particularly Asian style vegetables. Crucifer flea beetles, *Phyllotreta cruciferae*, are a pest of crucifers such as Asian leafy vegetables and some cut flowers, including Nasturtium and Stock. We tested the commercial row cover, Agribon®. This was found to be highly effective for protecting Asian vegetables such as ‘Pac choi’, if it is securely in place prior (preventing beetles from crawling under row covers) to crucifer flea beetle activity. Results of the second test (Fig. 1) show Agribon was effective until 3 August. Efficacy ended 3 August when flea beetles gained entry under the Agribon. Treated rows protected with Agribon resulted in 1/3 less flea beetles than rows without Agribon.

Fig. 1. Comparison between number of crucifer flea beetles on ‘Pac choi’ protected with Agribon to unprotected ‘Pac choi.’



Trap crops, visual barriers and plant architecture

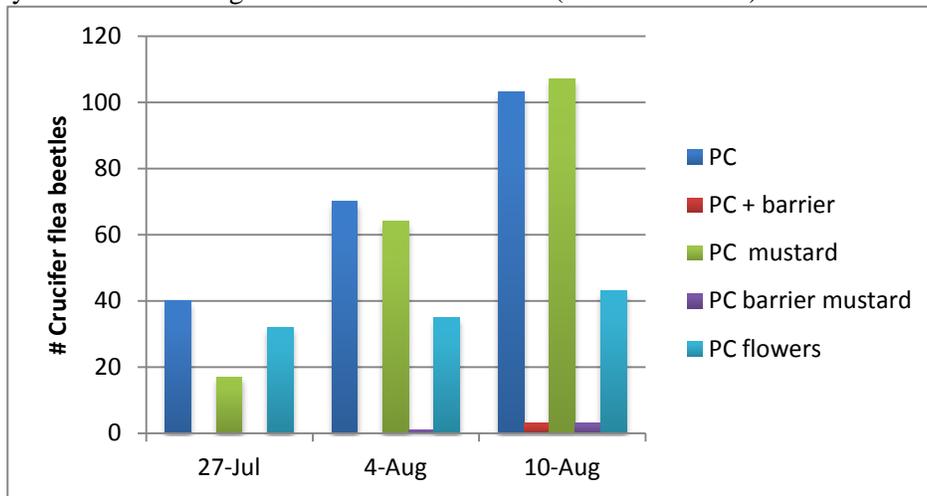
Four treatments were tested for efficacy against the crucifer flea beetle (Fig. 2). The Asian vegetable, ‘Pac choi’ was selected for testing the following 4 treatments: 1. Surrounded by freeway barrier. 2.

With freeway barrier and the trap crop, 'Golden mustard' planted on either side of the barrier. 3. Only the mustard trap crop on either side of the 'Pac choi'. 4. Using the architectures of short and tall cut flowers (snapdragons and dianthus) on either side of 'Pac choi' as a visual barrier. Figure 2 compares the different treatments for the second 2010 field trial.

Results of the 4 treatments in the second field trial arranged in order of most effective to least effective: 1. 'Pac choi' with freeway barrier. 2. 'Pac choi' with freeway barrier and the trap crop, 'golden mustard'. 3. 'Pac choi' with 'golden mustard'. 4. 'Pac choi' with annuals. These field trials differed from actual 'Pac choi' commercial plantings in that the trials were allowed to run beyond the harvestable date of 'Pac choi.' The results of the second trial are in agreement with the first field trial. The Hmongs indicated that use of freeway barrier for protection of Asian vegetables was feasible at the current cost of \$20/100.'

Results of the metallic mulch as a deterrent to thrips did not show convincing results to offset the price of the mulch.

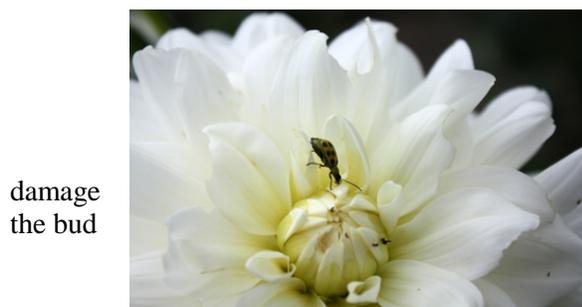
Fig 2. Efficacy of 4 treatments against Crucifer flea beetle. (PC = 'Pac choi')



Western spotted cucumber beetle and Lygus bug field trials

Western spotted cucumber beetle (WSCB), *Diabrotica undecimpunctata* and lygus bugs were identified as the most damaging pests of specialty cut flowers in western Washington. Both pests cause economic damage to flowers. Western spotted cucumber beetle chews holes in the petals and frass left behind in the flowers is difficult and time consuming to remove, making them unmarketable. This is particularly noticeable in light-colored flowers, especially white dahlias (Fig. 3). Lygus bugs inject saliva resulting in misshapen unmarketable flowers (Fig. 4).

Fig. 3. WSCB in white dahlia with feeding damage.



damage the bud

Fig. 4. Dahlia with Lygus damage.



Greatest occurs during stage. Field

tests were performed in 2011 and 2012 (Figs. 5 & 6). The 2011 field trials tested commercial chemicals available to growers possessing a pesticide applicator's license (Table 2).

Treatment	Average SCB/plot	SE
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Although three species of *Lygus* are found in Washington State, 2 species were collected and identified, *L. lineolaris* and *L. hesperus*.

Three chemical products (Table 2) were selected for testing because they were inexpensive and easily attainable if the grower has a commercial applicator's license. Of the three, only Conserve® is a biorational. Results indicated Talstar was most effective at controlling lygus (Fig. 5) followed by Conserve and malathion the least effective (Table 2).

Treatment	Average Lygus/plot	SE
Malathion 8EC	10.0	5.58a
Conserve SC	6.8	3.20a
Talstar 1	2.8	0.63b
UTC	12.8	3.99a

Table 2. Efficacy of select chemicals in controlling lygus bug.

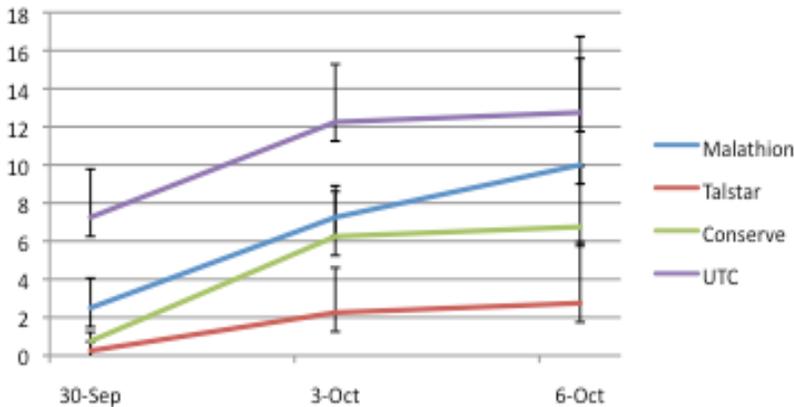
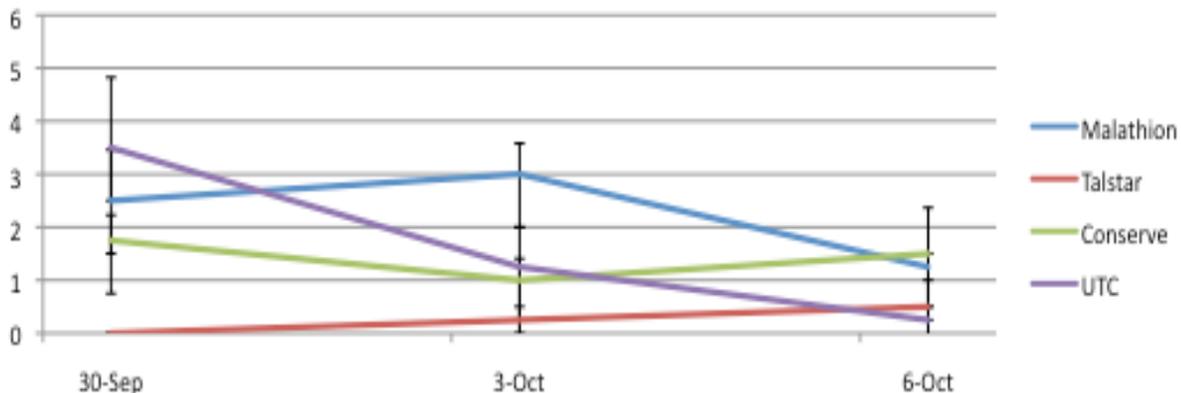


Fig. 5. Field efficacy of select chemicals for controlling lygus bug.

Only Talstar effectively controlled WSCB in the field (Fig. 6). Malathion and Conserve performed no better than the control (Table 3).

Fig. 6. Field efficacy of select chemicals for controlling WSCB.



Malathion	2.3	0.52 ^a
Conserve SC	1.4	0.22 ^a
Talstar 1	0.3	0.14 ^b
UTC	1.7	0.96 ^a

Table 3. Field efficacy of select chemicals in controlling western spotted cucumber beetle.

Means ± SE followed by the same lowercase letters in columns are not significantly different according to

ANOVA and Tukey’s HSD. ($P < 0.05$).

Because the Hmongs rely on “over-the-counter” insecticides for pest management, in 2012 we selected a range of products, representing 4 IRAC (Insect Resistance Action Committee) mode of action classes, suitable for controlling WSCB on an organic farm and a conventional Hmong farm or any flower farm where the grower is restricted to or prefers to use “over-the-counter” chemicals. Results at 1 DAT indicate that the “over-the-counter” insecticides have at least short-term efficacy on the target insect, western spotted cucumber beetle (WSCB) (Tables 4 & 5, Figs. 7 & 8). Both farms showed an increase in WSCB in the untreated plots from the pre-count to the 1DAT reading, with the greatest population increase in the organic plot. This is consistent with an overall smaller population in the conventional farm based on pre-counts at both farms (66 -conventional farm and 42 organic-farm). 1 DAT results from the conventional farm show suppression of WSCB in all treatments with the highest reduction (100%) in the Pyganic and malathion plots, followed by spinosad, which decreased the resident population by 50%. At the organic farm all three OMRI approved products also suppressed the resident populations but none of the products resulted in 100% decrease. On this farm the spinosad treatment performed the best with a 65% reduction in beetles present. The conventional farm showed an overall decrease in resident population of WSCB by 40% and the organic operated farm showed an overall decrease by 15%.

At 3 DAT overall beetle populations are decreasing. This could indicate the beetles are nearing the end of their second generation. Western spotted cucumber beetle passes through 2 generations in the summer months in western Washington, with a small peak in May and a larger peak in August. During this time, dahlia buds should be protected since injury can result in unmarketable flowers. Damage occurring as the flower opens is less severe and damaged petals may be removed. Efficacy for the “over-the-counter” insecticides began to drop off after 3DAT and before 5 DAT for all products. Likewise all treatments were similarly effective but with a fairly short 5-day residual. Relying alone on insecticides will require frequent retreatment and diligent rotation between mode-of-action, “over-the-counter” insecticides, for the duration of the blooming season. For the Hmongs, lacking long-term residual insecticide efficacy, use of insecticides alone will be costly for the 4-month vulnerable period. Some of the recommended cultural and biorational methods for controlling WSCB such as delayed planting, floating row covers and use of commercial beneficials are not feasible since planting cannot be delayed, row covers may damage the flowers and purchasing insectary beneficials are not an economic alternative. Since planting vegetable crops along with flowers is a Hmong tradition, use of squash as a trap crop could be investigated as a more sustainable way to decrease cut flower production costs. Increasing picking frequency will reduce the number of buds damaged. Additionally many of the above insecticides will also help reduce lygus bug damage.

Hmong conventional farm white dahlias	5 minute/plot Beetle Pre-count 6 Aug	1 DAT 7 Aug	3 DAT 11 Aug	5 DAT 13 Aug
UTC	12	18	3	12
Bifenthrin	8	5	0	2
Malathion	9	0	2	1
Pyganic*	10	0	0	3
Spinosad*	12	6	1	4
Neem*	6	5	0	1
Esfenvalerate	9	6	2	1
Total	66	40	8	24

Table 4. Cucumber beetle field trials on a Hmong farm using conventional, “over-the-counter” insecticides. * organic products.

Hmong organic farm white dahlias	Pre-count 6 Aug	1DAT 8 Aug	3 DAT 11 Aug	5 DAT 13 Aug
UTC	7	33	10	8
Pyganic	4	1	4	8
Spinosad	17	6	3	7
Neem	8	2	7	8
Total	36	42	24	31

Table 5. Cucumber beetle field trials on an organic Hmong farm using “over-the-counter” insecticides.

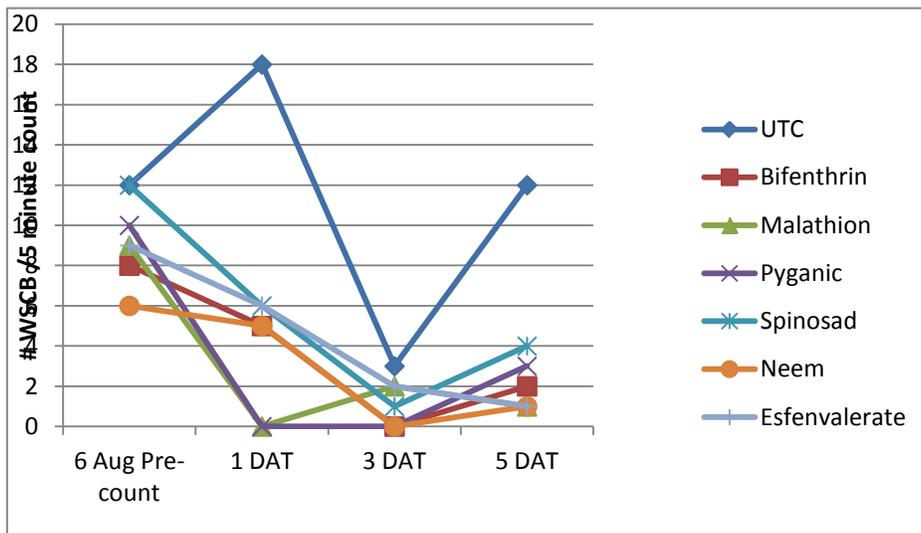


Fig. 7. Residual activity of WSCB insecticides up to 5 DAT on a Hmong conventionally operated farm.

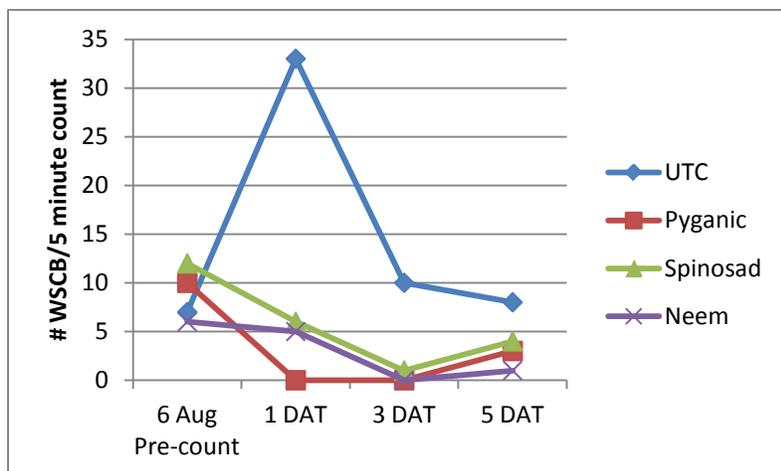


Fig. 8. Residual activity of WSCB insecticides up to 5 DAT on a Hmong organic farm.

Since the field residual tests on these two pests at the Hmong in Autumn 2011, several traditional growers have reported similar problems with these insect pests. Information regarding control of these cut flower economic pests based on this WSDA Specialty Crop Block research was provided at both jointly sponsored specialty cut flower grower's schools and at the ASCFG (Association of Specialty Cut Flower Growers) National Conference and Trade Show, Tacoma, Washington, 12-14 November, 2012.

A Specialty Cut Flower Growers School

WSU in collaboration with The Seattle Wholesale Growers Market presented two cut flower grower schools, 2011 and 2012 at WSU NWREC. The two-day classes targeted beginning and intermediate flower farmers in the Pacific Northwest but attracted out of state participants. Local flower farmers Diane Szukovathy of *Jello Mold Farm* and Vivian Larson of *Everyday Flowers* were joined by third generation specialty cut flower grower, Joe Schmitt of Fair Field Flowers, Madison Wisconsin. Focus was on sustainable growing techniques, a mandate of The Seattle Wholesale Growers Market and included both classroom and on-farm instruction to help students begin growing and selling high quality cut flowers. An industry panel discussion addressed a wide variety of questions from the participants. The grower school topics included:

- Business planning basics
- Plant selection
- Growing techniques
- Pest management strategies
- Specialized equipment
- Quality postharvest care
- Season extension
- Marketing opportunities

The 2011, specialty cut flower grower's school was held on 18 and 19 February. The school drew 50+ participants from 11 Washington counties and states as far as Pennsylvania. The workshop was advertised in newspapers and online. Attendee questionnaires indicated 100% positive responses with requests for an annual workshop.

Other responses suggest that small farmers in Washington are looking for ways to generate income and are specifically interested in specialty cut flowers, primarily because they are a non-food crop and under less strict regulation.

Although the Hmong cut flower growers were offered scholarships and free transportation, no Hmong attended the 2011 growers school. Three Hmong were participants in the 2012 growers school. Bee Cha's translation and encouragement marked the first formal co-attended training by Hmong and traditional cut flower growers (Fig. 9).

Forty-seven participants representing 10 counties (3 eastern Washington), 3 states and 2 countries attended the 2nd Cut Flower Growers School 24 -25 February 2012 at WSU NWREC. Beverly Gerdeman presented the section on cut flower pest management and Vicki McCracken and Jennifer Ringwood conducted an interactive economic marketing survey.

All 47 Growers School participants took part in a 15 question marketing survey designed to better understand participants' current or planned cut flower marketing activity and information needs. Half of participants (24 growers) had no prior experience selling cut flowers and little experience growing cut flowers. Participants indicated they planned to sell cut flowers as primary or supplemental income, or to diversify their farm business. Farmers markets, on-farm sales, and florists were the top markets where growers planned to sell in the short term, but many hoped to eventually sell mostly through the Seattle Wholesale Growers Market cooperative or on-farm sales. Time and labor to grow, followed by market access and financial resources were the top challenges facing participants. Forty percent of participants were interested in learning to develop a marketing plan. The survey results were used to design a more extensive growers survey and to guide content for the marketing strategy options memorandum to growers.



Fig. 9. WSU Hmong Program Coordinator and collaborator, Bee Cha (center), assisting 2 Hmong flower growers attending the 2012 specialty cut flower school.

Economics

The Cut Flower Industry: Overview

Activity: Background research on Washington State and the greater US cut flower industry using USDA data, global trade data, industry reports, trade articles and academic journal articles.

Results: The most dominant trends affecting domestic cut flower growers in recent decades are 1) increased volume and price competition from imported cut flowers, 2) increased sales of cut flowers through general retailers (e.g. grocery stores), and 3) increased sales of cut flowers through internet services. Although different sources disagree about the exact import share, it is generally estimated to be between 70-80 percent with Columbia, Ecuador, and Canada being the top three supplying countries. Increasingly the most popular imported flowers (roses, carnations, chrysanthemums, alstroemeria, tulips, lilies, and mini-carnations) are being sold through mass merchandisers, supermarkets, wholesale clubs, etc. Domestic growers are instead focusing on growing specialty cut flowers where they have a competitive advantage.

Recommendations: Domestic growers should (and are) focusing on specialty cut flower production. Creative marketing strategies and product quality differentiation is needed to reach customers in alternative outlets other than mass merchandisers, etc. that rely on cheap, imported flowers.

The Cut Flower Industry: How Cut Flowers are Bought and Sold in Washington State

Activity: More than 15 interviews cut flower industry members including representatives from 3 floral wholesalers, 1 growers cooperative wholesale market, 3 local grocery chains, 3 national grocery chains, 2 studio florists, 1 distributor, and 1 floral design educational institution.

Results: Floral wholesalers buy locally grown flowers, but at lower prices and higher volume. Some are specifically interested in working with local growers, others have little/no interest. National, mass merchandising grocery stores primarily source flowers through their own national distribution systems or through large, local wholesalers and do not have the flexibility to work with local growers. Values-driven retailers (oriented toward organic, “natural”, local, or other specialty products) were already sourcing some locally grown flowers or seemed interested in doing if growers were able to meet certain requirements. Studio florists are interested in local sources for high quality, unique flowers, but still need to purchase flowers from traditional floral wholesalers because of price, volume, and product consistency. Themes about local flowers emerged from all industry interviews, including:

- Definitions of cut flower quality differed greatly by flower type, but freshness, correct stage of harvest (bloom stage), long stem length, and lack of blemishes were most commonly mentioned
- Locally grown flowers are perceived to be fresher and generally of good quality, but challenges to sourcing more locally grown flowers included seasonality, unpredictable harvest schedule, correct varieties for cut flower use, and lack of growers’ compatibility with retailers’ purchasing systems.
- In general, the end consumer is not requesting locally or sustainably grown flowers at the businesses interviewed (grocery stores, florists, and wholesalers/distributors).

Recommendations: Some Washington businesses are sourcing (or are interested in sourcing) locally grown flowers and are models of innovative relationships between growers and businesses that purchase flowers. Growers with high quality flowers, as defined above, may be successful in securing profitable business relationships by seeking values-oriented grocers, wholesalers, and florists, or working collectively with other growers in a formal way (such as the Seattle Wholesale Growers Market Cooperative) or informal way to form cooperative marketing groups to buffer the challenges of working with individual local growers (e.g. seasonality, volume, distribution, etc.).

Cut Flower Growers in Washington State

Activity: One growers survey during the 2012 Specialty Cut Flower Growers School (47 respondents) and one online survey of cut flower growers across Washington State (73 respondents).

Results: Growers School survey: Over half of respondents were new to growing and marketing cut flowers (57%). Most growers (52%) intended to market flowers for primary or secondary income; 26% planned to use flowers to diversify a current farm business. As a group, growers most commonly sold or planned to sell flowers through farmers markets, on-farm or U-Pick sales, direct to florists, or through subscription services. In the long-run, many growers hoped to sell primarily through the Seattle Wholesale Growers Market (27%) or through on-farm or U-Pick sales (27%). Participants felt competition from imported flowers and customers’ low price expectations were the greatest challenges facing all Northwest-grown cut flower growers. WA Cut Flower Growers Survey: Seventy-three Washington growers partially or completely responded to the survey; 74% are current cut flower growers, 22% are future cut flower growers, and 4% are former cut flower growers. Fifty-five percent of growers used less than 1 acre for commercial cut flower production, while 19% used between 1 and 3 acres, 20% used 3 to 6 acres, and 6% reported using 6 or more acres. Current growers sell through a wide variety of channels. Only five growers (10%) sold all of their products through wholesale channels while 26 current growers (52%) only sold through direct marketing channels. The most commonly used direct marketing channels were farmers markets (46%) and do-it-yourself wedding/event sales (44%). The most commonly used wholesale channel was sales to florists (33%). Most growers identified consistent sales (83%), fair price (73%), and “relationship with buyer” (67%) as the most “important” factors in deciding where to sell flowers. As a group, growers “usually” or “always” used pricing strategies based on comparison with other growers’ prices (79%), setting high prices initially and adjusting by sales (43%), and cost of production (42%). Only six responding growers (13%) depend heavily on cut flowers sales for their total household income. Nearly half of growers (46% or 21 growers) derive 25% or less of their household income from farm income, of which cut flowers may only be a small part. Growers were asked why they

sold (or planned to sell) cut flowers and were allowed to identify multiple motivations; 52% said “supplemental income”, 26% said “primary income”, and 47% said “to diversity my farm business.”

Recommendations: A major finding of the growers’ surveys was growers’ objectives for their cut flowers businesses and their current or planned marketing channels. There appears to be a natural stratification of growers in terms of goals for their cut flower sales. A minority of growers in our surveys rely on cut flower sales as primary income, while the majority sells flowers as a side business or within the context of a food-growing farm business. Profit motivations, production practices, and preferred marketing channels may differ significantly depending on how important cut flower sales are to the grower. Growers will need to differentiate themselves from other local growers to appeal to their desired markets, especially in outlets with higher quality standards and profit potential. Many growers plan to or are pursuing on-farm sales and direct marketing as their primary sales channels; these channels are less formal and have more flexible quality requirements than sales to florist or specialty grocery stores. Analysis is on-going to determine characteristics of different grower groups in terms of farm business goals, product and production practices, and marketing strategies.

Hmong Flower Farmers, Farmers Markets, and a Bouquet Pricing Study

Activities: Farmers market bouquet pricing study and Hmong flower farm harvest data, designed to document the price level for fresh cut flowers (sold as mixed bouquets) at farmers markets in the Seattle area and estimate per stem retail prices to help Hmong farmers estimate crop values for insurance purposes and baseline comparison for considering alternative market opportunities.

Results: The relative price level of cut flowers at farmers markets was evaluated using pricing information from the Seattle Wholesale Growers Market Cooperative (SWGMC). It is very important to note that we are not assuming the flowers at the farmers markets in this study and the flowers at SWGMC are equivalent products. The bouquet pricing study did not include any quality assessments or other subjective comparisons between cut flower products. The average price of a mixed bouquet at a farmers market was 53% of the price of a bouquet with the same number of stems and flower types at SWGMC. Farmers markets with a higher concentration of cut flower vendors (all Hmong vendors, in this study) had a lower average cut flower price level. The data documents the potentially low profitability situation at farmers markets that is frustrating to both the Hmong and other growers.

Recommendations: The pricing study establishes very important baseline data for the price level of cut flowers at farmers markets and per stem prices that Hmong farmers can use to evaluate profitability, estimate crop values for insurance purposes, and consider alternative market options in the future. Price and value are determined by many factors, including what customers are willing to pay for product attributes that they value in a product (e.g. longevity, convenience, volume, quality, etc.). Hmong bouquets are very popular at farmers markets, but the current low prices are a challenge for Hmong farms. Product quality assessment was not a part of this pricing study; in order to expand sales beyond farmers markets Hmong farmers, researchers, and industry experts must objectively assess current flower quality characteristics. Many Hmong farms grow good quality flowers and have clear potential to move into other markets, but Hmong growers would need to overcome perceptions about the quality of their flowers by demonstrating adoption or improvements in flower quality (e.g. longevity, stage of harvest, stem length, pest and disease management, etc.) and postharvest management (e.g. sanitation for tools, buckets, and water, temperature control, etc.) in order to establish buyer confidence and receive potentially higher prices outside of farmers markets. Using our baseline data, future research could facilitate consultations with alternative market buyers and floral experts to objectively and specifically identify reasonable changes to production and postharvest management that would prepare Hmong farmers to sell cut flowers in other markets, if that is a goal for their farm business.

Cut Flower Consumers in Washington State

Activity: Online survey of 500 consumers in Washington State (general population, over age 18). The survey was written by the economists and was managed by the online research company, Qualtrics and its partners.

Results: The survey topics include cut flower purchasing habits (preferred location, important flower characteristics, reason for purchase, spending levels, frequency, etc.), food purchasing habits (similar questions in order to relate food and floral purchasing behavior, since locally grown food is a highly related market trend), opinions about cut flowers, and knowledge of plants, cut flower care, and imported cut flowers. Data collection is on-going, but 400 complete responses were recorded as of 12/13/12. Select preliminary results based on these 400 respondents are included here. Sixty-one percent of Washington consumers purchased cut flowers in the last 12 months for either personal or gift use. Grocery stores, supermarkets, supercenters, and wholesale clubs were the most common places people typically bought flowers (69-84%), but approximately 53% of people have purchased flowers from one or more direct marketing outlets, with farmers markets and roadside stands being the most common. Fifty percent of respondents said they knew where to buy locally grown flowers in their area; 70% said they would buy locally grown flowers if they were readily available. When purchasing cut flowers, the most important characteristics identified from a list (in no particular order) were “available where I usually shop”, “color”, “fragrance”, “longevity (vase life)”, “price”, and “quality of blooms and foliage.”

Recommendations: Once the survey is completed, more extensive analysis will be done on different consumer segments within the 500 respondents to determine what marketing messages, sales channels, and product attributes consumers will respond to most favorably when marketing locally grown flowers. Preliminary results suggest that consumer awareness about locally grown cut flowers is modest, but many people are interested in buying locally or domestically grown flowers, or flowers that “help keep farmers in business.”

The role and contributions of project partners were as follows:

Entomology: The entomology team facilitated entomology field research planning, implementation and analyses of data. The team identified the major insect pests of specialty cut flowers in Washington state, western spotted cucumber beetle and Lygus bug. Results provided information on efficacy of biorational/sustainable approaches, such as usefulness of plant architecture and road barriers to minimize pest infestation and field-testing of both commercial and “over-the-counter” insecticides to control major flower pests in western Washington. Information was presented to two cut flower grower’s schools. The entomology team planned, co-hosted and participated in the 2011 and 2012 grower’s schools.

Marcia Ostrom and Bee Cha of the WSU Small Farms Program have been instrumental in facilitating contact between Hmong farmer collaborators and researchers, allowing on-site farm visits and interviews. Bee provided transportation and instantaneous English/Hmong translation for Hmong attending the cut flower grower’s school.

Economics: Diane Szukovathy and Dennis Westphall (Jello Mold Farm and founding member of the Seattle Wholesale Growers Market Cooperative) provided critical insights and feedback during numerous stages of the economics research activities. The Seattle Wholesale Growers Market Cooperative also provided valuable technical information and assistance. Bee Cha, the Hmong Outreach Coordinator in Carnation, WA was instrumental in arranging harvest data collection, explaining challenges facing Hmong farmers, arranging farm visits, and providing input for the bouquet pricing study. Business people in the Washington cut flower industry were generous with their time in granting interviews and sharing information about the workings of their business. Numerous growers and other researchers reviewed surveys for technical accuracy and content, and have offered assistance in distribution results through professional networks.

An abbreviated description of the economics/marketing activities and most significant findings and conclusions are included here. Appendices corresponding to each activity are included at the end of the report and contain more detailed summaries and visual representation of results.

GOALS AND OUTCOMES ACHIEVED

Entomology

The following Expected Measurable Outcome was related to Entomology: **A 50% increase in cut flower growers adopting one or more of the new pest management strategies.**

Although the efficacy of several sustainable approaches to pest management was tested in cut flowers, the team failed to detect an increase in growers adopting any of these strategies at this time. The proposal was written based on limited knowledge of the pest issues and grower challenges of both the traditional and Hmong growers. Following this research it is clear that the projected measurable outputs were off-target. The research instead revealed a complex group of factors contributing to each group's pest management approaches and why the above measurable inputs were not achieved.

Initial surveys to understand the major pest issues indicated the traditional growers, non-Hmongs, considered lack of market as their primary concern over that of pest issues, commenting "We can grow the flowers, it's the market we need." (conversation with Gretchen Hoyt, Alm Hill Gardens, 2010). Additional interviews with other traditional cut flower growers further substantiated Hoyt's statement. These cut flower growers ranged in size from 2 – 100 acres (n = 12), 75% of them represented 10 or less acres, similar to statistics provided by our economics team. Smaller sized acreages are more manageable because of logistics and time requirements therefore amenable to non-chemical approaches, allowing more flexibility in pest management options. In addition, Washington's traditional growers are interested in promoting sustainable management, enhancing quality of their cuts and providing a competitive edge over cheaper imports, as evidenced by the Seattle Wholesale Growers Market mission statement. Nevertheless, we performed research on a variety of sustainable and conventional methods (Project Approach section 4) and presented results of this at the cut flower growers' school and the national ASCFG convention. This information will be available for growers on the project website.

Hmong flower farms are primarily operated by older farmers, constrained by language and less apt to seek assistance. In contrast with the traditional growers, Hmong on-farm visits revealed larger populations of pest insects, in part because the Hmong farms visited were larger acreages than the average traditional growers farms, typically leased, with larger monoculture plots attracting more pests. Use of sustainable approaches, such as metallic mulch and road barriers are costly and less effective on large acreages unless plots are subdivided. Subdivision creates logistic problems for mechanical use, required by larger acreages such as plot management where rows are hilled by tractors and rototillers are commonly used for weed control. Efficient use of this machinery requires long unbroken plots or at least plot sizes and configurations that allow a tractor to pass around/through without damaging plants.

Other approaches such as use of trap crops may be unrealistic, requiring spraying trap crops with insecticides to prevent insects immigrating to flowers, additional work for laborers already challenged to meet harvest dates. Many traditional growers can pick early and often (cultivar dependent) but without a walk-in-cooler, Hmongs' picking schedule is not as flexible. Hmongs were observed to overplant to compensate for anticipated insect damaged flowers resulting in a large volume of wasted flowers particularly of high-demand varieties such as white dahlias, which growers recognized as more attractive to insects such as the Western spotted cucumber beetle.

Pest management for traditional growers is driven by their target market, with a high-level, knowledge support system. The support includes university extension, researchers and yearly growers' schools offered by The Seattle Wholesale Growers Market Cooperative whose mandate encourages sustainable

approaches. Challenges for the Hmong are greater, due to their cultural/language constraints. Their knowledge support system is limited. While university support exists, the Hmong growers often do not regularly seek assistance. Based on on-farm observations, outreach focusing on safe, effective use of chemicals may be a more immediate benefit than adoption of additional sustainable pest management techniques, but is beyond the scope of this grant. An effective approach to improving Hmong insecticide handling and use might be to focus on safety, through on-farm, site-specific, individual farmer trainings.

Access to Hmong farms was difficult and limited to a few cooperating Hmong farms. Despite limited Hmong farm access, the team is confident in its identification of the primary pest problems for the Skagit, Snohomish and Whatcom Counties since pests identified on the few Hmong farms were the same for the traditional growers. For the final year the team had planned for on-field insecticide trials with 2 additional Hmong farms, but the farms ultimately opted not to participate. As the project proceeded, the understanding of the complex nature of the cut flower industry in Washington state naturally evolved, directing the team's efforts toward areas of most concern and potential outcome. The results of this work will be useful to further the industry, already much changed from the inception of the project.

The following activities were also performed:

- Test the potential of plant architecture and visual barriers in managing insect pests of cut flowers. On-station (WSU NWREC) field trials were conducted to test the above methods. Sampling and evaluation was performed on a weekly basis.
- Field test select biorationals and novel chemicals for key pests. On-farm trials were performed on four Hmong farms. Plots were established and 5-minute timed pre-counts/plot were taken prior to the treatment applications. Five –minute timed counts/plot were taken at 1 DAT (days after treatment), 3 DAT and 5 DAT. Bee Cha assisted to translate safety information to the participating Hmong growers.
- Pictorial diagnostic guide for pests of specialty cut flowers. Photos of insect pests and damage were taken on both the traditional and Hmong farms. The challenge of conveying this information effectively to a non-language grower remains challenging and further investigations will require continued collaboration with the Hmong coordinator.

All planned activities were completed, except the pictorial guide to insect pests of western Washington specialty cut flowers. Accomplishing this activity for an ethnic group with no written language is challenging. Although photos of the insects and resultant damage are complete, additional text on life cycle and control measures need to be drawn in a pictograph style that will still retain some detail and will require additional assistance and advice from Bee Cha, the Hmong Program coordinator.

Economics

The following Expected Measurable Outcome was related to Economics: **A 5-10% increase in sales in small-scale cut flower growers in Washington State (including the Hmong) by the project end.**

Domestic cut flower growers as a group, including those in Washington, have experienced sales decreases due to pressure from increased, cheaper imported flowers in recent decades and additional decreases in recent years due to the slow economy. Given these confounding factors, it would be very difficult to detect net increases in sales directly attributable to this grant as the original Expected Measurable Outcome states. However, the project team expects the intermediate and long term effects of this grant will contribute to increased small-scale cut flower growers' sales, and may have already positively impacted cooperating growers' sales in the short term. Additionally, significant steps were taken to support increases in sales through the following project activities:

- **Growers school marketing panels.** Marketing panels included experienced sellers and retail floral buyers at two growers schools. Over 70 current and future growers benefited from these

panels. Only 10 growers school attendees responded to the survey conducted in the final year of the grant, so it is difficult to assess the growers school's impact on sales; eight growers reported sales between \$1-\$4,999 and two reported sales between \$5,000-\$9,999. Four were beginning sellers reporting first year sales.

- **Improvements in pest and disease management possibly increased the volume of saleable cut flowers (i.e. reduced waste).** Several members of the Seattle Wholesale Growers Market Cooperative shifted sales away from less profitable channels in order to sell more through the quality-driven wholesale market. Improvements in sustainable pest management helped some of these growers reduce waste, thereby increasing the volume of high quality products available for sale through the wholesale market. Growers school attendees also benefited from pest management information, but the impact on reduced waste and sales is not known.
- **Baseline data on farmers market retail prices.** Estimates of per stem retail values for Hmong flowers sold at Seattle area farmers markets provides a baseline for measuring future profitability in current or alternative market channels. This data was gathered in the final year of the grant.
- **Sales and marketing data was collected from 45 small-scale, Washington cut flower growers, a group underrepresented in USDA floriculture surveys.** The USDA reported the wholesale value of Washington cut flowers was \$22.3 million in 2011, 68% of which was tulip sales. Only 59 producers were counted in 2011, most of whom were bedding plant producers. Our 2012 growers survey supplemented the USDA data by gathering cut flower sales data from 45 small-scale growers: 67% reported sales below \$10,000 in a typical year, hence they would not be included in the USDA floriculture survey. Our data may serve as a baseline reference for future assessments of small-scale growers' sales.

One of the primary objectives of this project was to identify marketing opportunities to improve cut flower farm profitability for both traditional and Hmong flower growers, who currently face many cultural and market barriers in selling cut flowers. In the first year of the grant, there were several changes in the economics portion of the research team. Under the original project proposal, the proposed grant objectives included developing enterprise budgets for cut flower farms to evaluate profitability under alternative production and marketing scenarios, with special attention to developing alternative market opportunities for Hmong farmers. When the current economists joined the project, it was decided that more information was needed about current marketing challenges and market needs before specific, well-informed recommendations could be made to growers about production or marketing. The revised goals were chosen to document:

- The structure, players, and nature of competition within the Washington cut flower industry, considering the increasingly global context of cut flower trade and associated pressure on domestic, small-scale growers;
- Product and marketing requirements for specific marketing channels, especially channels mostly willing or able to buy locally grown flowers;
- The current capacity (or potential ability) of Washington cut flower farmers to capitalize on the identified market opportunities.

Therefore, some of the original project objectives were revised or delayed and instead completed the following:

1. More than 15 interviews with cut flower industry members including representatives from 3 floral wholesalers, 1 growers cooperative wholesale market, 3 local grocery chains, 3 national grocery chains, 2 studio florists, 1 distributor, and 1 floral design educational institution.
2. Two surveys of current and future cut flower growers involving 47 and 73 growers each.
3. One bouquet pricing study involving 7 farmers markets and 36 bouquets to document farmers markets' price level, competition within farmers markets, and comparison with other locally marketed flowers.

4. Harvest data from two Hmong flower farms over a 5 month growing season to document harvest levels, waste, and crop valuation.
5. One consumer survey of 500 Washington consumers about cut flower purchasing habits and interest in locally grown cut flowers.

The findings and recommendations based on these completed activities will be formally written and published as WSU Extension publications, articles in trade/industry press, and distributed through the networks of growers and industry advocates, many of who have specifically requested to receive documentation of project findings. Academic publications will also be pursued to contribute to the research community's dialogue about locally or sustainably produced products and small-scale agriculture.

All planned activities were completed, except for the consumer survey. As of 12/13/2012, 400 of the contracted 500 responses had been completed by the contracted online research company, Qualtrics. The survey is expected to close by 12/17/2012, at which time analysis of results will begin immediately. Analysis and dissemination of additional results are in-progress.

BENEFICIARIES

All Washington cut flower growers will benefit from higher quality blooms through increased information on major insect pests of cut flowers and sustainable methods for control. This is in keeping with their mandate for sustainable, fresh, local flowers.

Growers survey results will draw attention to the importance of cut flowers to small-scale agriculture. The consumer survey results will provide very specific information about what customers want in cut flower products, greatly improving the marketing information available to Washington growers. The consumer survey will also be a critical contribution to the state and national level discussion about and promotion of the domestic cut flower industry; Washington will have some of the best data in the country about cut flower consumers, generating additional awareness.

Hmong growers will benefit from having the only known data estimating per stem retail prices for flowers they sell at farmers markets. This data may incentivize Hmong growers to keep harvest records in order to assess current profitability, consider revenue potential in other markets, and estimate crop values for insurance purposes.

Documentation about the definition of "quality" in cut flowers will help all Washington cut flower growers identify ways to improve cut flower quality and expand into more lucrative markets, if that is a relevant business goal.

All findings will help inform and leverage the work of the Seattle Wholesale Growers Market Cooperative as they execute their own SCBGP project in the next few years, further developing as a national model for marketing locally grown flowers to high-end florist and retail customers.

The current economic impact of the project is currently unknown, but data and results generated from the growers surveys, the consumer surveys, and the bouquet pricing study will be made available to the hundreds of small-scale cut flower growers in Washington. The data will provide information on consumers and market channels that previously did not exist, and will help inform growers' marketing strategies going forward. The bouquet pricing data will help Hmong farms estimate crop values for insurance purposes and may motivate some Hmong farms to evaluate current profitability and potential for expansion into alternative, more profitable markets.

LESSONS LEARNED

Entomology

Insect pest management is market driven. Washington's cut flower industry is stratified between the Hmongs focused on large volume at farmer's markets and tourist venues such as Seattle's Pike Place Market, while the traditional growers have developed an additional niche through their grower owned wholesale growers market. The farmer's market clientele is more tolerant of insect damage and primarily focused on bouquet appeal through color and volume/dollar value. The traditional growers however are concerned with developing the state's industry through promoting fresh, local quality flowers and demand a higher standard for insect/damage free flowers. These two systems uniquely mirror the ability of each group to successfully manage insect pests since economic damage threshold is also two-tiered. The two grower groups can exist in harmony while meeting the needs of the state's cut flower consumers.

The project team was surprised at the overall lack of insect pest issues on cut flowers. The traditional growers have developed efficient methods in planning, crop selection and continually select new varieties with pest issues in mind. They are eager to share their knowledge to promote the industry, which was evident by the development of the wholesale growers school. Many are members of the ASCFG (Association of Specialty Cut Flower Growers), a valuable national organization providing information including pest management and expertise to their members. The Hmongs are limited by their language barrier, to easily access new information, such as information on pest management and pesticide use. They intentionally overplant, anticipating loss from insect damaged flowers. Assistance to help the Hmongs will remain primarily within their own community and through outreach by WSU experts such as the Small Farms Program.

The pictorial guide to insect pests was not completed due to the challenges of writing a guide for an ethnic group lacking a formal written language. The team will explore the possibility of creating a pictograph style that would be instructive for the Hmong cut flower growers and will continue to look into different formats for non-language communication.

Economics

This project confirmed and formally documented some of the local and global marketing challenges facing Washington cut flower growers. An important insight from the project was the natural stratification of growers along both cultural lines (Hmong and non-Hmong) and cut flower business types (full-time cut flower farm vs. diversified food-focused farms vs. supplemental income "side" business). While Washington growers statewide would benefit from greater promotion of locally grown flowers, individual growers have different business objectives (primary vs. supplemental income) and resources (time, capital, knowledge, local demand) that influence how they grow and sell flowers. Growers' objectives and resources will also influence whether they adopt research recommendations that promote goals not aligned with their specific interests. In the present case, some Hmong farms may be content to meet the current expectations of farmers market customers at current prices, while other Hmong farms may adopt or demonstrate quality and business practices that allow them to sell flowers in more profitable markets. Channels for local flowers differ in price and product requirements, as evidenced by the industry interviews, so both Hmong and traditional small-scale cut flower growers must carefully consider how their business goals align with the product requirements (e.g. quality, expected longevity, volume, etc.) and profit potential in different market channels.

The original proposal included the Expected Measurable Outcome of a 5-10% increase in sales in small-scale cut flower growers in Washington State (including the Hmongs) by the project end. When the current economists joined the project in the second year, this outcome was delayed until more was understood about growers and marketing strategies that may lead to improved profitability. Prior to this grant, little was known about the decentralized, small-scale cut flower growers across Washington State; few belong to the national Association of Specialty Cut Flower Growers and fewer are likely to be

included in USDA data on floriculture crops. In building the contact list for the growers survey, it was apparent that comprehensive baseline and annual surveys of cut flower growers' sales would require multiple modes (email, mail, phone, and in-person interviews) and intensive resources, and would still likely miss many growers who make casual sales for supplemental income. The team instead focused resources on growers actively seeking improvements in production and profitability through the growers schools and related networks, and on Hmong farmers struggling with low price situations in their current markets. In the final year of the grant, the team gathered baseline data on Washington growers' production and sales, Seattle area farmers market retail prices, and Washington consumers' current cut flower purchasing habits. Future studies may use this data to measure increases in sales or price levels, and changes in consumers' local purchasing habits (i.e. frequency of purchasing local flowers).

With the improved understanding of Washington growers' diverse situations, future outreach should be tailored to different grower groups' specific farm business goals, geographic production and marketing opportunities, and cultural preferences for learning new production and marketing strategies, within and beyond the growers schools. Grower groups identified include full-time cut flower growers (including both traditional and Hmong growers), part-time cut flower growers, and diversified farms with a cut flower component. The team will tailor its results and recommendations to each group, but were unable to document a 5-10% increase in sales across this diverse grower group due to the short-term impact of this grant, at this time.

Research activities and outreach during the course of the grant was met very enthusiastically by cut flower growers, business persons, industry advocates, and researchers at other institutions. Many people have requested results from this project and hope to utilize our data and results in their own efforts to improve small-scale cut flower farm profitability and promotion of Washington and domestically grown cut flowers. This project stimulated interest and discussion beyond original expectations.

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ADDITIONAL INFORMATION

"Business is Blooming," Washington State Magazine, Summer 2011.

Washington Wine Commission
Washington Wine Promotion in Emerging Markets

PROJECT SUMMARY

Washington State wines have gained exposure in new and emerging markets in recent years. They have also gained recognition among leading wine journalists, which has created demand for Washington State wines among importers around the world. However, many of these importers are unfamiliar with Washington State wines. They may have read about the region but few have had the opportunity to visit Washington wine country or sample a range of wines from the state. At the same time, few Washington wineries understand opportunities available to them in emerging markets. They focus attention on traditional wine importing countries such as those in Europe or in Canada and Japan. The purpose of this project was to increase market awareness, distribution and demand for Washington wines in two key wine markets: India and Mexico.

The Washington State Wine Commission continually seeks to develop and expand export markets for Washington State wines. Though the vast majority of Washington State wines are sold domestically, foreign markets play an important role in stabilizing outlets for the State's growing grape and wine production. Moreover, the U.S. remains a leading wine import market and annually, competition for sales in the United States among global producers intensifies.

The WSWC pursued this SCBGP project in 2009 because the organization had just recently brought a number of trade contacts from India and Mexico to the state to tour its wine regions. The guests were part of the Washington State Wine Experience, a bi-annual event that seeks to introduce foreign trade and media to Washington State wine through a week-long tour and educational activities. The tour piqued the interest of buyers from both markets and the SCBGP presented an opportunity to secure additional funds that would permit follow-up promotional/educational activities to take place in-country. It is one thing for contacts from these countries to visit Washington State and to meet with suppliers while here. But it is equally important for Washington State suppliers to demonstrate a willingness to export to these markets, and to support distribution there through promotional events. The SCBGP project was done for this purpose and with the long-term goal in mind of developing India and Mexico as growing markets for Washington State wines.

With the increasingly competitive landscape in the worldwide wine market thanks to the growing popularity of new wine regions in Australia, New Zealand, South Africa, and South America, it is imperative for Washington wines to establish an international presence in burgeoning markets now to build market share as a world class wine-producing region.

PROJECT APPROACH

Below is a summary of tasks per target market.

Mexico

The Washington State Wine Commission (WSWC) held its Taste Washington – Cancun event on October 6, 2010. It included a seminar and trade/media tasting at the Hilton Cancun. WSWC then followed that up with a seminar and tasting in Mexico City in January 2011. That tasting was coordinated through the U.S. Embassy in Mexico City. It was held at Restaurant Syrah, a venue arranged by the U.S. Agricultural Trade Office.

Key accomplishments for the Mexico work plan were as follows:

- An RFP was issued and a contractor was selected to assist with in-country planning and logistics. Specifically, WWC worked with Imalinx, a contractor based in Cuernavaca, Mexico.
- The Hilton Cancun was selected as the venue for the tasting.
- A seminar was led by Shayn Bjornholm, Director of Education of the WWC for **46 trade members**, covering Washington Geography, wine industry in the state and main varietals, and a comparative tasting with other U.S., Australian and Mexican Wines.
- A Tasting event for the HRI sector followed, with attendance of **165** sommeliers, Food and Beverage managers from hotels and restaurant owners.
- Ten representatives from Washington wineries attended the Cancun event. In total, **59 different wines** were presented, with 24 different varietals and blends.
- In Mexico City, a seminar was conducted by Juan Munoz Oca, winemaker for Columbia Crest winery. The seminar was conducted in Spanish to 36 trade and media guests. It was followed by a tasting of 14 Washington wine brands from five different wineries with distribution in Mexico City.

The tastings and seminars surpassed expectations. Attending winery representatives commented on the quality of Mexican trade that attended the tasting. The level of interest in Washington wines was very high.

India

Washington wine tasting events took place in New Delhi and Mumbai the week of September 4, 2011. These included trade and media tastings and more private importer wine dinners in each city. The events began in Mumbai with an importer dinner at Ziya in the Oberoi Hotel. Twenty-seven guests participated, which was slightly lower than the 35 targeted. This was despite RSVPs that exceeded 35 and that were confirmed numerous times prior to the event, including on that same day. The following night, the trade tasting took place at The Leela Hotel. Fifty-five contacts attended. The following day was for travel to Delhi. In that city, the Oberoi hotel hosted the trade tasting on the 8th (for over 80 guests) and a wine dinner on the 9th, for 29.

Representatives from the Washington wine industry attended all of the events. From the Washington State Wine Commission, Ryan Pennington (Communications Manager) and Madeline Dow (Marketing Manager) attended. They helped pour at the events and were on hand to discuss the Washington State Wine Commission as a generic promotional body. Al Portney (Ste Michele Wine Estates) also attended to represent the many brands that Ste. Michele offers, many of which have distribution in India. Other industry members were heavily recruited to represent their products as well, but unfortunately this was not possible. Owners of Hedges Cellars (another large exporting winery in the state) intended to participate but had to change their plans due to a family issue. Some brands were represented by their importers. In total, eighteen different Washington State wine brands were featured at the events.

Each year of the SCBGP project, information on exports and distribution to the two markets was collected through industry surveys. Those surveys were completed each year in August/September. The surveys helped determine whether the projects achieved certain goals that were laid out in the original proposal. Specifically, the WSWC established two criteria as expected outcomes for this project. First, the WSWC would measure success by examining increased distribution in Mexico and India resulting from the project. The goal was to achieve new distribution for 6-10 wines. Second, the WSWC anticipated that the project would result in an increase of 100% in overall wine sales to the two markets.

It does not appear that the WSWC met its quantitative goals on either measure. On the first criterion, the WSWC is aware of new distribution for Washington wines in Mexico, where at least three Washington wineries had secured additional distribution as of early 2011. But with the latest export survey

completed, it does not appear that any additional new distribution occurred. In India, one importer issued a trade lead to begin importing wine from one specific Washington winery that has not previously been available in India. This was potentially for substantial volume. However, that Washington winery was sold this past year and the company was not in a position to enter new trade agreements while the sale was pending. It appears that this lead had since grown cold. That said, other issues prevented the Washington wine industry from meeting its goal for new distribution in India. The country's tax structure for imported alcoholic beverages makes all but the cheapest Washington wines nearly unaffordable. Importers are generally only looking at wines at the lowest price point and there are not too many Washington wineries capable of delivering wine at their asking prices. Success in India was (and still is) possible and the tax regime there is changing, so there were a number of reasons why activity there made sense. The timing seemed right to do events that built upon the interest of Indian wine importers and that might help gain additional exposure for Washington wines in the hotel sector in a market that is expected to be sizeable when it ultimately opens. And in the end, there was definite interest among certain importers to bring in specific Washington brands. The ultimate problem seemed to be that there was a disconnect between the premium products the wineries wanted to provide to the market and the lower-end products that the importers were interested in. Importers wanted to start with low-end products while the industry is looking to establish its brand at the premium end. In any case, it is clear that WSWC did not reach its goal of at least 6 new brands in distribution.

On the second criterion, total exports to both markets grew at the outset of this project, but have since tapered off. As a result, it does not appear that the industry will have met its goal of 100% growth in exports to the two markets. In India, Washington wine exports grew by over 360% by value from 2009-10 to 2010-11 but in 2011-12, Washington wine exports to India contracted. Exports last year were less than \$100,000. One of the two major exporters to the market saw sales decline considerably. Thus sales to India following the project were actually below where they were at the beginning.

In Mexico, exports for 2010-11 did not grow substantially over the prior year despite some small wineries securing new distribution in that market. Their volumes are small but opening a new market for a small winery is an important gain. For 2011-12, exports to Mexico were again up, albeit slightly. Exports totaled over \$226,000. Over the course of this project, Washington wine exports to Mexico have grown by 11.3%, still far from the expected outcome of the project.

In terms of conclusions and recommendations, there were lessons learned in both markets. These included:

- It was good approach to select a location within a new target country that is already an established market for U.S. wines. This was the case with Cancun and Delhi and Mumbai, though volumes sold in those cities are small.
- Follow up is critical to ensure that new distribution is achieved. In India, one Washington winery missed out on a significant sales opportunity because an export contact at the winery was not identified. The original winery contact that was in place at the outset of these activities left her position shortly after completion of the India events. Indian importers interested in wine from that company attempted to reach the winery to discuss sales possibilities but a suitable replacement for these negotiations was never identified.
- For future events, sample shipment should include a larger buffer time, preferably three weeks to ensure sample delivery.
- For future activities, a communications calendar between WSWC, wineries, their distributors, and in-country contractors working on the projects should be put in place to make sure that details and information is appropriately shared between all parties.

- There is interest in Washington wine among Indian trade and recognition that Washington wineries make premium products. However, the market's tax structure is extremely difficult to work with and prices most Washington wines out of reach for importers and retailers.
- India's regulatory requirements for wine import are also cumbersome to deal with and discourage wineries from pursuing the market.
- Advance press outreach is critical to trade and media attendance.
- The WSWC cannot count on industry representatives attending international events despite expressions of interest and/or intent at the outset of a project.
- Further activity in India is not recommended until such time that India's regulatory environment improves. However, India importers should continue to be encouraged and invited to visit Washington State. Further activity in Mexico should be considered if Washington State wineries already doing business there show substantial sales growth over the next few years.

The WSWC did not have many project partners for these events. United States Department of Agriculture personnel provided significant assistance and attended the events. In Mexico, USDA officials secured the venue and assisted with outreach to the trade and media for the WSWC's tasting and seminar in Mexico City. In India, the US Ambassador attended and spoke at the tasting in Delhi. The WSWC also could not have completed the projects without the support of in-country representatives in both places. Imalinx (Mexico) and Wine Forays (India) were instrumental to the events, handling all of the local logistics including invitations and outreach. Ste. Michele Wine Estates was also a significant contributor to the project. Ste Michele made available its Spanish-speaking winemaker to lead the seminar in Mexico City (at no charge to the WSWC) and provide important insight and contacts in both markets.

GOALS AND OUTCOMES ACHIEVED

The activities that were completed as part of this project were all described in the previous section. They included tastings, seminars and wine dinners in New Delhi and Mumbai, and tastings and seminars in Cancun and Mexico City. These events all attracted influential importers, distributors, and media in each market and positioned Washington wine brands for exposure and new business. Ultimately, the goals for the project were to support new distribution for Washington wines in both countries. Achievements against those goals are described below.

As mentioned, the WWC established two expected outcomes for this project:

1. Gain distribution for 6-10 new Washington wines in each market by matching interested wineries without representation with interested importers in both markets.
2. Increase the overall sales of Washington wine in each market by 100% over the course of a three-year period.

The WSWC did not meet either of these goals by the completion of the project. While gains were made in each market, those gains were ultimately reversed or diminished in subsequent years. Trade barriers are a primary constraint in India but in both markets, it simply appears that interest among Washington State wineries is minimal. There are other, larger markets for Washington State wines, and for small wineries in the State, these larger markets often take precedence.

The following table contains a full list of tasks associated with the project and information on whether the task was completed, eliminated or changed.

MEXICO	
Task/Activity	When Completed
Begin research on event dates, event format and target invitees with in-market trade contacts and wineries active in the market (importers, current customers and supporters of WA wine)	Winter, 2009/2010
Perform baseline survey on current level of Washington wine distribution and annual sales volume and value	January – March 2010
Develop a detailed activity plan and budget	April 2010
Negotiate and confirm agreement with hotel venues	April/May 2010
Develop a participation package, itinerary of events, and matching contribution requirements for wineries	May 2010
Recruit and register participating wineries	May/June 2010
Deliverable 1: Conduct trade tasting & education seminar event in Cancun	October 2010
Deliverable 2: Trade tasting & education seminar event in Cabo San Lucas	Canceled, replaced by Mexico City seminar
Post event wrap-up, follow-up and survey of results	October 2010
Deliverable 3: Seminar at Restaurant Syrah	January 2011
Deliverable 4: Conduct “Washington Wine Month By-the-Glass” Promotion	Canceled – budget required for India activities.
Survey results in 6 month intervals for 3 years	Surveys conducted annually each summer

INDIA	
Task/Activity	When Completed
Begin research on event dates, event format and target invitees with in-market trade contacts and wineries active in the market (importers, current customers and supporters of WA wine)	March, 2011
Perform baseline survey on current level of Washington wine distribution and annual sales volume and value	Fall 2010
Identify and select contractor to assist with in-market activities	January 2011
Deliverable 5: Visit to Washington State by in-market contractor	April 2011
Develop a detailed activity plan and budget	May 2011
Negotiate and confirm agreement with hotel venues	June 2011
Develop a participation package, itinerary of events, and matching contribution requirements for wineries	June 2011

Recruit and register participating wineries	July 2011
Execute pre-event logistics	August 2011
Deliverable 6: Trade tasting & education seminar event in Mumbai	September 2011
Deliverable 7: Trade tasting & education seminar event in New Delhi	September 2011
“Washington Wine Month By-the-Glass” Promotion Program – Mumbai and Delhi	September 2011
Post event wrap-up, follow-up and survey of results	October/Nov. 2011
Submit final assessment of project effectiveness and results	November 15, 2012

In 2009, there were 6 Washington wineries exporting to Mexico and 4 wineries exporting to India. By the close of this project, the numbers have not changed dramatically. In Mexico, the WSWC is aware of 8 wineries exporting to Mexico. The number of wineries exporting to India may actually have decreased with only two now reporting sales there based on the most recent export survey.

In terms of sales increases, Washington State wine exports to Mexico and India have gone in different directions. Exports to Mexico are up slightly over the three year period with growth exceeding 11% by value. To India, however, exports are down from 2009 despite a significant increase after year 1. Exports in 2011-12 were approximately half of exports in 2009-10.

The conclusion from these results is that these two markets may represent niche opportunities for certain Washington State suppliers, but they are unlikely to present substantial volume opportunities for the State. Moreover, moderate (at best) interest from the wineries makes a long-term commitment to the two markets unlikely. This will complicate efforts by the WSWC to build a strong base of exports to both countries.

BENEFICIARIES

A total of 10 wineries sent representatives to Mexico, with 14 wineries participating and nearly 60 wines featured. In India, 18 wineries participated. At this point, only a handful of wineries have directly benefited from the completion of this project. Those are the wineries that had or have distribution in the two target countries. That said, the promotional activities in both countries secured media coverage and raised awareness of Washington State wines among certain influential trade targets, media, and to a lesser extent consumers. The following quotations were received from participants in India, as an example....

“The events were organized beautifully and the best part is that the execution was very wine friendly. Especially doing the events over 2 days with the trade tasting on the first day and the proper pairing the wine with food at the dinner on the second day was really good. It completely enhanced the whole experience. To be frank, I wouldn’t have come on the second day if I hadn’t become such a fan of Washington wines. We go to several tastings like Chilean or Australian wine events, but this was very well planned. After the tasting I have already initiated the order for all my 3 restaurants to have Columbia Crest and Chateau Ste Michelle -which are available in India. Will introduce others as well once they get to one of the wine importers. Though having attended these events, one idea my partners and I are considering is to import some of these

wines ourselves as they really are good quality and match up to Napa or Bordeaux region's wines.” – Saurabh Khanijo, Director –Kylin, Sartoriaand KylinPremier Restaurants

“I think it was an absolutely brilliant idea to have an event like this which promoted the Washington State wines, particularly because the US portfolio in India has traditionally been dominated by Californian wines. The first step was to bring awareness of the wines to the Indian market, but more importantly the wine tasting dinners confirmed that this is a quality product. Following this introduction to the Washington State wines, I will certainly consider listing some of them at The Table in the near future.” – Gauri Devidayal, Proprietor –The Table (one of the top wine restaurants in Mumbai)

An argument can therefore be made that the whole of the Washington wine industry ultimately benefitted from the project, even if exports have not immediately grown as a result. Export market development takes time. It hinges on relationship-building and increasing awareness and interest in these new products. Certain importers and trade contacts certainly now have a better understanding of Washington State wines following the project than they had prior to it. That may not have paid off in immediate sales opportunities for wineries not yet in the market, but it should facilitate market entry for new brands in the years ahead.

The WSWC's expected measurable outcomes were quantitative measures related to exports to Mexico and India and to the number of wineries with brands in distribution in the two countries.

LESSONS LEARNED

Lessons learned were outlined earlier in this report in the activity summary. These included:

- It was good approach to select a location within a new target country that is already an established market for U.S. wines. This was the case with Cancun and Delhi and Mumbai, though volumes sold in those cities are small.
- Follow up is critical to ensure that new distribution is achieved. In India, one Washington winery missed out on a significant sales opportunity because an export contact at the winery was not identified. The original winery contact that was in place at the outset of these activities left her position shortly after completion of the India events. Indian importers interested in wine from that company attempted to reach the winery to discuss sales possibilities but a suitable replacement for these negotiations was never identified.
- For future events, sample shipment should include a larger buffer time, preferably three weeks to ensure sample delivery.
- For future activities, a communications calendar between WSWC, wineries, their distributors, and in-country contractors working on the projects should be put in place to make sure that details and information is appropriately shared between all parties.
- There is interest in Washington wine among Indian trade and recognition that Washington wineries make premium products. However, the market's tax structure is extremely difficult to work with and prices most Washington wines out of reach for importers and retailers.
- India's regulatory requirements for wine import are also cumbersome to deal with and discourage wineries from pursuing the market.
- Advance press outreach is critical to trade and media attendance.
- The WSWC cannot count on industry representatives attending international events despite expressions of interest and/or intent at the outset of a project.
- Further activity in India is not recommended until such time that India's regulatory environment improves. However, India importers should continue to be encouraged and invited to visit Washington State. Further activity in Mexico should be considered if

Washington State wineries already doing business there show substantial sales growth over the next few years.

The WSWC successfully implemented tastings and seminars in both markets and there was solid interest among the trade and media. Participation among the Washington wine industry was reasonable, though a bit lower than anticipated in India where original projections suggested a few more wineries would join the program. What was perhaps more surprising was the lack of direct winery representative attendance. Despite initial feedback that winery representatives would travel to the events on behalf of their brands, this was not always the case. In India specifically, only one representative attended the tastings. Other brands were represented generically by WSWC staff. This likely diminished the effectiveness of the presentation to importers and undermined the message of commitment to the market.

The WSWC's expected measurable outcomes were not achieved for this project. A few key lessons learned include:

- Ensure broad support in advance for the project – in the WSWC's case firm support existed among a small number of wineries in the activities in both countries. Initial surveying suggested that more wineries would participate but their participation did not materialize. Their interest in these markets was lukewarm and the travel distance (and cost) at least for India was prohibitive.
- Identify realistic measures – the WSWC set lofty goals for this project, but in hindsight an expectation of 6-10 new wineries in each market was unrealistic, at least in the sense of new distribution agreements during the course of this project. Wineries that participated in the tastings may still secure new agreements over time, but it was unlikely that so many wineries would reach agreements after only one tasting event in each market. More of a sustained presence is likely needed.
- Economic factors matter – this project occurred during a downturn in the US economy that likely caused many wineries to re-focus attention domestically. Wineries that would otherwise have participated in the project elected not to because the timing was not right to pursue these less-traditional wine markets.

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ADDITIONAL INFORMATION

Cash and in-kind match totaled approximately \$49,000.

Pear Bureau Northwest
Healthy Fruits Lead to a Healthy Family

PROJECT SUMMARY

Health and wellness are becoming bigger priorities for Mexicans. Mexican consumers are becoming more aware of growing health problems like obesity, diabetes, and more. Obesity is an oncoming epidemic in Mexico, which has the first highest percentage of obesity in the world – adults and children. As of the year 2010, 70% of adults in Mexico are considered obese compare to just 20 years earlier, when only 10% of Mexicans were obese. Like in America, the increase in the junk food, fast food and increased sedentary lifestyles has created the conditions for this epidemic. This problem affects young children with over 4.5 million children ages 5 to 11 considered to be overweight or obese. Therefore, nutrition, healthy diets and a healthier lifestyle are increasingly important to Mexican consumers. And with the recent outbreak of the Swine Flu in Mexico, having a healthy lifestyle, eating lots of fruits and vegetables, and having a good immune system has been made an even more important priority. As such, health and nutrition are hot topics in Mexico and this program provided a very timely promotional activity.

Mexico is one of the most important markets for Washington growers of apples, pears and cherries. Its proximity to the US makes it naturally one of our largest trading partners. This project positively impacted the state's approximately 1,217 pear growers, 3,500 apple growers and 2,500 cherry growers immediately through increased sales during the promotional period; and in the long-term with an improved positive association with pears, apples and cherries as a healthy and nutritious product that is a great value for the consumers' money. With consumers purchasing behavior changing due to the economic recession, consumers need to be reminded of all the positive reasons to buy Washington apples, pears, and cherries. Health-related reasons are becoming more important drivers for consumer purchases.

In terms of the economic impact to the state, all 3 industries represent over \$2.25 billion in revenue for pear, cherry and apple growers and constitute 5.25 percent of all of Washington's food and agriculture revenue. Mexico is the largest export market for pears and represents nearly 20 percent of the total crop and over 40 percent of all exports. In terms of values, pear exports to Mexico reached nearly \$60 million in 2008-09. For Washington Apples, Mexico is also its largest export market and accounts for nearly 30 percent of total exports. In 2008-09, Washington Apple exports to Mexico reached \$169 million. Mexico is a new market with a huge growth potential for Washington state cherries. In 2008, NW Cherry growers shipped 74,000 boxes worth \$3.56 million dollars to Mexico. Being able to conduct large-scale promotions such as this helps to build a strong promotional presence in Mexico. This in turn helps increase the overall demand for the products, resulting in better overall prices and returns to the grower.

The Healthy Fruits Lead to a Healthy Family was a two part promotion focusing on an in-store video promotion with all Wal-Mart stores in Mexico and nutritionist workshops in front of or inside of Soriana stores for a period of 1 month per retail chain per commodity group for a total of 6 months of promotional activity in Mexico. The Healthy Fruits Lead to a Healthy Family promotion targeted women age 24-48 with children and highlighted the nutritional benefits of pears, apples and cherries and how regular consumption (along with daily exercise) leads to a healthier lifestyle. The promotion helped increase sales of pears, apples and cherries with the two largest retail chains in Mexico, as well as help position pears, apples and cherries as a healthy fruit choice in the mind of the consumer.

When the promotion took place, pears and cherries were facing a retaliatory tariff in Mexico, so this promotion acted as an incentive for the two top retailers to carry larger volumes and additional varieties during the promotional period. At this time, all three products are facing retaliatory tariffs in Mexico.

The timeline of the project was divided as follows:

	March	April	May	June	July 10 th	August 10 th
Walmart	Pears	Apples			Cherries	
Soriana		Apples		Pears	Cherries	

PROJECT APPROACH

A well-respected Doctor in Mexico – Dr. Diane Pérez – was hired as the spokesperson for the project. Dr. Pérez is a famous and well-known opinion leader due to her renowned 20-year journalistic career in television and radio, such as the health segments of Televisa, Latin America’s largest communications company. In addition, several food and drug companies have hired her to do various advertising campaigns. Finally, Dr. Pérez has her own website and presents a radio show that airs on a major radio station in Mexico City – Radio Trece 1290AM.

Dr. Pérez appeared on the informational video regarding the nutritional benefits of eating pears, apples and cherries that was run at Wal-Mart stores; her image also appeared on the POS and consumer materials used in the Nutritionist Workshops with Soriana. Utilizing Dr. Pérez as the medical spokesperson gave more credibility to the health-related messages.

The video provided a presence at Walmart stores nationwide. The video appeared on screens located throughout the stores, as well as in the cashier lines. Originally planned to be shown at 56 stores in three cities (Mexico City, Guadalajara and Monterrey), through negotiations (see Lessons Learned), Walmart agreed to show the video in 106 stores nationwide.

A nutritionist team carried out the Nutrition Workshops outside (and sometimes inside) of Soriana stores promoting nutritional values, seasonality and characteristics of each fruit, teaching consumers how to obtain a healthier life style by including apples, pears and cherries in their daily diet. A total of 361 Soriana stores were covered, reaching 722 sampling days in Mexico City, Guadalajara and Monterrey. During these promotions 106,508 consumers were reached. The average sales increase was 252% compared with a normal period – 277% for apples, 263% for pears and 216% for cherries. Market research was carried out in order to evaluate these two campaigns, obtaining the following results:

- The most important aspects for consumer awareness of each fruit:
 - ✓ Pears – Fiber content, vitamins, nutritious, healthy and digestion helpers
 - ✓ Apples – Fiber content, prevent cancer, vitamins, healthy and prevent high cholesterol
 - ✓ Cherries – Prevent cancer, vitamins, contain antioxidants, nutritious & healthy
- The information provided was consistently considered “Good-Excellent” and “very useful”
- In general, people knew more about apples than they did about the other two fruits
- After receiving the information, people who did not typically buy the fruit were more willing to buy it; and for current buyers, they will increase the amounts they purchase
- In general, focusing on fiber content and disease prevention were the health aspects with the highest impact

Soriana Support

- Most of the people knew that those providing information were nutritionists and they rated higher all the aspects regarding the information itself. They rated lower the facilities and promotional materials.

Walmart Support

- The video spot by Dr. Diane Pérez was positively evaluated, since most of the people knew her (72%), and they consider her an expert on health and well-being issues.
- They rated highest the clarity of information and lowest the way in which the information was delivered.

Both activities were very successful. In Walmart, success rested on the use of a very well-known spokesperson and in Soriana with the personalized nutritionist consultancy.

Each participating cooperator also conducted their own in-store sampling promotions, PR activities and advertising in addition to this promotion, in order to optimize each group’s promotional program.

GOALS AND OUTCOMES ACHIEVED

Both activities – the Walmart video and Soriana Nutritionist Workshops – achieved the performance goals by promoting and increasing sales of Northwest Pears, Washington Apples and Northwest Cherries.

During Soriana Nutritionist Workshops, sales increase on average 252% compared with a normal period without promotion – 277% for apples, 263% for pears and 216% for cherries. During Walmart TV promotion, 75% of interviewed consumers mentioned that after seeing the video they were somewhat willing to buy the fruit being promoted and the remaining 25% mentioned that they were totally willing to buy the fruit, meeting goal 2.

Performance	Baselines 2008	Targets 2009	Results 2010
Consumers who reported that information will influence their purchase behavior positively to buy more Northwest fruits	52%	60%	75%
Consumers who eat at least 3 servings of fresh fruit and vegetables a day	42%	49%	53%
Consumers that participated in the nutritionist workshops or saw the promotional video became more educated about Northwest Fresh Fruits	33%	40%	60%
Consumers who consider health and nutrition important purchase decision motivators	29%	37%	78%

BENEFICIARIES

This project positively impacted the state’s approximately 1,217 pear growers, 3,500 apple growers and 2,500 cherry growers immediately through increased sales during the promotional period; and in the long-term with an improved positive association with pears, apples and cherries as a healthy and nutritious product that is a great value for the consumers’ money. During these promotions average sales increases were 277% for apples compared with a normal period, 263% for pears and 216% for cherries.

Pear imports during the 2009-10 season (when this promotion was carried out) increased 23.6% compared with 2008-09 according to the Pear Fresh Committee. Apples decreased their imports volume 5%, but increased imports in terms of value by 13% according to the Global Agricultural Trade System

(September-May). Cherries imports increased by 20% compared with 2009 according to the World Trade Atlas (June-August).

Consumers also benefited from this project. Obesity is an oncoming epidemic in Mexico, which has the highest percentage of obesity in the world. Therefore, nutrition, healthy diets and a healthier lifestyle are increasingly important to Mexican consumers. The Soriana workshops provided direct nutrition consulting to consumers regarding pears, cherries and apples, and reached 106,508 consumers.

Ociel López, a Soriana Buyer, said, *“Consumers liked it a lot and nowadays it is very important to teach them how to reach a healthier life by including fruits.” “Great support for the chain and for the produce department.”*

Victor Manuel Padilla, a Walmart Buyer said, *“We like to have these ads in our stores because consumers have in mind buying different fruits, therefore increasing sales in the department.”*

LESSONS LEARNED

This was the first time that Walmart TV was used as a promotional activity tool and at the beginning there was some uncertainty about the results; however, it turned out to be a very good media to promote these products. Consumers paid close attention to the information on the screens during their visit to the store and while in the cashier line. The content of the video, plus the well-know spoken person, were critical for this success. It was also determined that using a well-known spoken person gave additional value to the promotion because consumers trusted her, which provided even more credibility to the campaign.

At the beginning of the Walmart project, it was discovered that several televisions in stores were not working. After discussing the problem and negotiating, Walmart agreed to project the video at 106 stores, instead of only at 54 stores, as originally planned. Walmart also agreed to keep each video live for 8 weeks instead 4 weeks, increasing the frequency 152%. The total cost to include the additional stores and time would have been \$79,916 - 121% more than what was actually paid.

Overall, it was confirmed that consumers are very receptive to information that could help their family to have a better life style.

CONTACT PERSON

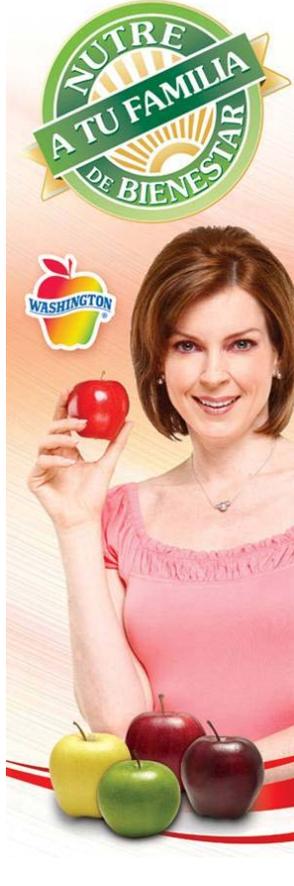
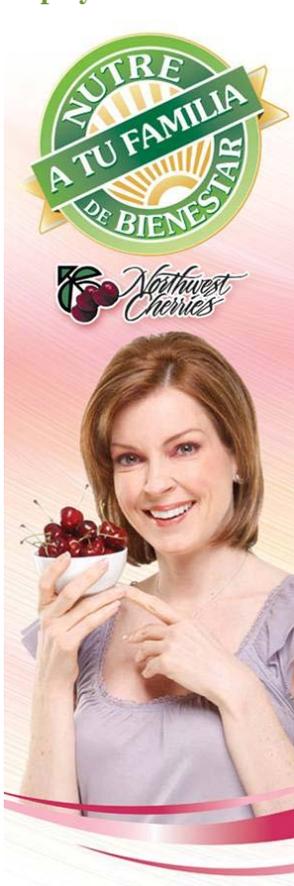
Jeff Correa, International Marketing Director
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ADDITIONAL INFORMATION:

Banners



Displays



Consumer Brochure

Los alimentos nos proporcionan nutrientes como proteínas, hidratos de carbono, grasa, vitaminas, minerales y agua.

Las frutas proporcionan principalmente hidratos de carbono, vitaminas y minerales, son fuente de fibra y además contienen fitonutrientes. Cada fruta proporciona diferentes cantidades de vitaminas y minerales.

A continuación encontrarás las funciones de algunos nutrientes contenidos en las frutas.

Actividad	Beneficio
Vitaminas	<p>Vitamina A Es recomendable comer el tomate: Ayuda a mejorar el funcionamiento del sistema nervioso.</p> <p>Vitamina B Favorece el crecimiento muscular, proporciona energía y potencia la actividad metabólica y contribuye en la formación y mantenimiento de huesos, nervios y piel.</p> <p>Vitamina C Ayuda en una gran variedad de funciones, es capaz de mejorar la actividad metabólica, es importante en la formación de huesos y en el mantenimiento de la estructura de los tejidos y en el transporte de hierro.</p> <p>Vitamina E Es un antioxidante eficaz. Tiene la capacidad de proteger al organismo contra diversos tipos de cáncer y es importante en el mantenimiento de algunas enfermedades.</p>
Minerales	<p>Calcio y fósforo Ayudan a la formación de huesos, dientes y células musculares. Estos minerales se encuentran en la leche y en el queso, pero también se encuentran en algunas frutas.</p> <p>Ciudadanos El consumo de cítricos reduce el riesgo de padecer enfermedades.</p> <p>Hierro Ayuda a regular los flujos y minerales de las células de la sangre para las contracciones de los músculos y para el flujo sanguíneo.</p> <p>Proteínas y ácidos Proporcionan energía de manera rápida. También se utilizan para el crecimiento normal del tejido muscular, contribuyen a regular los niveles de azúcar en la sangre.</p>
Hidratos de carbono	<p>Almidón Es un tipo de fibra soluble que ayuda a regular el tránsito intestinal y a regular los niveles de azúcar en la sangre.</p> <p>Fibra Es un tipo de fibra soluble que ayuda a regular el tránsito intestinal y a regular los niveles de azúcar en la sangre.</p> <p>Almidón Es un tipo de fibra soluble que ayuda a regular el tránsito intestinal y a regular los niveles de azúcar en la sangre.</p> <p>Fibra Es un tipo de fibra soluble que ayuda a regular el tránsito intestinal y a regular los niveles de azúcar en la sangre.</p>
Otros nutrientes	<p>Carotenoides Favorecen la absorción de nutrientes y ayudan a regular los niveles de azúcar en la sangre.</p> <p>Flavonoides Son antioxidantes que pueden ayudar a reducir el riesgo de padecer enfermedades.</p> <p>Polifenoles Favorecen la absorción de nutrientes y ayudan a regular los niveles de azúcar en la sangre.</p>

Cerezas del Noroeste

Las Cerezas del Noroeste que se cultivan en el estado de Washington son la botana perfecta; además de saludables, los niños las adoran por su dulce sabor. Están disponibles en los meses de junio a agosto.

VALOR NUTRIMENTAL
Además de tener un alto contenido de fibra, no contienen grasas ni colesterol y de ser una gran fuente de vitamina C, las Cerezas del Noroeste están llenas de potentes fitonutrientes. Se considera que los antioxidantes contenidos en las cerezas, incluyendo quercetina y antocianinas, reducen el riesgo de padecer ataques al corazón, apoplejías y demencia cerebral y ayudan a proteger al organismo del cáncer. Las cerezas además son buena fuente de alcohol polifenol, malonatina y varios fitonutrientes más que pueden ayudar a la prevención de la formación de células cancerosas, a aliviar el dolor y a disminuir la inflamación asociada con la artritis y la gota.

- VARIEDADES**
- Chelan** Cereza redonda con vaina de buen tamaño, es la menos susceptible a agrietarse cuando se moja.
 - Tieton** Cereza de tamaño extraordinariamente grande, con excelente firmeza y un dulce sabor suave.
 - Bling** La fruta es firme, jugosa y de color rojo profundo o color oscuro; es la cereza de extraordinaria y fina calidad con un vibrante e intenso sabor.
 - Balchier** Cereza muy atractiva, de tamaño grande, color amarillo con un rubor rojo brillante, tiene un sabor delicado y una textura de pulpa muy fina.
 - Lapras** Cereza grande con excelente firmeza y sabor; es altamente resistente a agrietarse cuando se moja.
 - Skeena** Es una cereza grande, muy firme y dulce; su color es rojo oscuro y una ocasional negra.
 - Sweetheart** Cereza grande de color rojo brillante, tiene un dulce sabor suave y una firmeza excepcional.

Manzanas de Washington

Las Manzanas de Washington están disponibles de septiembre a agosto.

VALOR NUTRIMENTAL
Por su contenido nutricional (fibra, antioxidantes como flavonoides y ácidos naturales), las manzanas proveen al organismo de saludables beneficios; contribuyen a reducir el riesgo de padecer enfermedades crónicas incluyendo afecciones del corazón, infartos, cáncer, diabetes, asma y destiempo de tejido de las células del cerebro asociado con el Alzheimer. Además pueden ayudar a eliminar el exceso de peso corporal y funcionan como "cepillo de dientes natural" ya que limpian y blanquean los dientes.

- VARIEDADES Y USOS**
- Braeburn** Rápidas, de intenso agrio sabor y de consistencia muy firme. Son muy buenas frescas, en ensaladas o cocinadas ya sea en payo o puré.
 - Cameo** Dulce y crujiente, con pequeñas manchas blancas en la piel. Mantiene su textura por largos períodos. Excelente para prepararse en ensaladas, payo, en salsas y hornadas.
 - Cripps Pink** De color rosa sobre fondo amarillo; consistencia firme y crujiente; ácida y de suave sabor dulce. Excelente para comerse a mordidas y para cocinarla en payo o como puré.
 - Empire** Tiene sabor agrio y es muy crujiente. Excelente para ensaladas y para disfrutarse a mordidas.
 - Fuji** El color de su piel va del amarillo verdoso al amarillo dorado cubierto con rayas rojas o completamente rojo; es muy aromática, dulce, jugosa y con textura firme. La Fuji es ideal para disfrutarse fresca.
 - Golden Delicious** Su piel es de color amarillo verdoso; ideal para comerse a mordidas por su jugoso y dulce sabor.

Granmy Smith

Manzana de color verde brillante, por ser muy crujiente y tener sabor agrio es ideal para todos los usos, principalmente para disfrutarse a mordidas o en postres.

Jonagold Por su textura firme y sabor agrio dulce es excelente para cocinar y hornear.

Red Delicious Manzana con cáscara roja brillante, ideal para comerse a mordidas por ser crujiente, dulce y muy jugosa.

Rome Manzana de forma redonda y piel color rojo intenso, es ligeramente dulce. Ideal para hornear y preparar postres con azúcar o jirobo.

Royal Gala Muy deliciosa cuando se disfruta a mordidas por ser aromática, jugosa y dulce.

TIPS PARA CONSERVARLAS
Las manzanas contienen el sabor, color y textura ideal para que las saborees en el momento en que se te antojan; colócalas en el frigorífico o refrigéralas para disfrutarlas frías y que duren más tiempo.

Peras USA

Washington, Yakima, Mid-Columbia y Madford son 4 regiones de Oregon y Washington que cuentan con el clima ideal y el suelo volcánico increíblemente fértil que permite cultivar las mejores variedades de peras: las Peras USA, las cuales están disponibles de septiembre a junio.

VALOR NUTRIMENTAL
Las Peras son una de las frutas con mayor contenido de fibra, por lo que la sanidad intestinal por más tiempo de un modo sano y natural. Además contienen vitamina A, C, potasio, calcio, fósforo, hidratos de carbono, proteína, glucosa y fructosa. Debido a que son tan versátiles, puedes disfrutarlas a cualquier hora del día.

VARIEDADES Y USOS
Anjou y Anjou Rojo Tienen forma de huevo, ideales para disfrutar su sabor en fresco o en ensaladas. Las puedes combinar con quesos.

Bartlett y Bartlett Rojo
Variedad con la clásica forma de campana; la Bartlett cambia de color de verde a amarillo al madurar. Conocidas también como peras manzanilla por su suavidad, son ideales para saborear su sabor en fresco y para elaborar pasteis y conservas.

Bosc
Su cuerpo es simétrico, con cuello alargado y piel color café oscuro. Por su sabor dulce y textura crujiente es ideal para elaborar pastas, tartas y panes.

Comice
Variedad de color amarillo verdoso, algunas veces con un rubor rojo; de forma redondeada, con cuello y tallo cortos. Su jugosidad la hace ideal para disfrutarse fresca.

Ferallie
Para de forma acampanada, de color amarillo dorado con rubor rojo brillante al madurar; su pulpa muy dulce y jugosa la hace idónea para combinarla con quesos.

Seckel
La más pequeña de las variedades; de forma elíptica y piel color café oscuro o verde olivo; su gran sabor dulce y su tamaño pequeño la hacen ideal para los niños.

MADURACIÓN
Para saber si una pera está madura, haga la prueba del pulgar; presión suavemente la base del tallo, si está suave, ya está lista para disfrutarse. Cuando están maduras, las Peras son muy dulces y jugosas.

La Bartlett es la única variedad de pera que manifiesta un cambio dramático de color cuando madura, cambiando de color verde a amarillo.

Si las peras no están maduras, colóquelas en una bolsa de papel por un lapso aproximado de 2 a 3 días a temperatura ambiente durante 4 o 5 días.

Si ya están maduras y no las va a consumir, refrigéralas para mantener su calidad.

Copas de Arroz y Cerezas

INGREDIENTES

- 1 taza Arroz de Washington
- 1/2 taza Arroz cocido
- 1/2 taza Cerezas
- 1/2 taza Mantequilla
- 1/2 taza Leche
- 1/2 taza Azúcar

PREPARACIÓN
Mezclar el arroz cocido con el arroz crudo, la mantequilla y el azúcar. Colocar la mezcla en un molde de 8 pulgadas de diámetro y hornear a 350°F durante 30 minutos. Decorar con cerezas y servir.

Pasta Alla Crostini con Peras

INGREDIENTES

- 1 taza Pasta
- 1 taza Peras cortadas en cubos pequeños
- 1/2 taza Mantequilla
- 1/2 taza Leche
- 1/2 taza Azúcar
- 1/2 taza Mantequilla

PREPARACIÓN
Mezclar la pasta cocida con la mantequilla y el azúcar. Colocar la mezcla en un molde de 8 pulgadas de diámetro y hornear a 350°F durante 30 minutos. Decorar con peras y servir.

Copas de Manzana con Tiramisu

INGREDIENTES

- 1 taza Manzana
- 1 taza Tiramisu
- 1/2 taza Mantequilla
- 1/2 taza Leche
- 1/2 taza Azúcar

PREPARACIÓN
Mezclar la manzana cocida con el tiramisú y el azúcar. Colocar la mezcla en un molde de 8 pulgadas de diámetro y hornear a 350°F durante 30 minutos. Decorar con manzanas y servir.

www.cerezasnw.com

www.perasusa.com

www.bestapples.com

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Soriana Nutritionist Workshops



Walmart TV Ad



Washington State University
Increasing Profitability with Organic Orchard Floor Management Alternatives

PROJECT SUMMARY

Washington is the leading national producer of organic apples, pears, and cherries, with these crops having an estimated annual value exceeding \$150 million. Organic fruit from Washington are prized by consumers for their exceptional eating and nutritional qualities. Two-thirds of the organic orchardists in the state rely on tillage for weed control (based on unpublished December 2008 survey data). Tillage is generally effective for weed control. But over time, tillage is implicated in deteriorating soil conditions and declining tree performance, including smaller fruit. In 2008/09, many organic apple growers received lower revenue for organic fruit relative to conventional fruit due to small fruit size. A loss of one or two fruit sizes can make an orchard unprofitable. Some organic growers have gone bankrupt in part due to declining fruit size. In addition, many irrigated orchards in Washington have soils with low native organic matter and soil texture is commonly coarse. Soil tillage works against attempts to increase organic matter, and therefore jeopardizes meeting the National Organic Program (NOP) standard regarding “maintaining or improving soil quality” (Sec. 205.203).

This project was designed to examine whether two alternative orchard floor management systems would perform better than a tillage-based system in terms of tree performance, soil condition, and economics. The project focus and design was based on feedback from surveys of commercial growers, conversations with growers, and contradictory results from research trials. Orchard floor management impacts tree nutrition, weed control, soil quality, tree performance, rodent damage, yields, fruit quality, production costs, and value of fruit sales. Relative to conventional orchard production, where low cost and effective options are available, organic growers find weed control, tree nutrition, and rodent control to be more challenging and typically more expensive. Poor weed control can cause nutrient deficiencies in the tree, obstruct sprinklers, and increase rodent habitat, all of which can have negative economic impacts. While more weeds might detract from tree growth and yield, increased vole populations due to poor weed control can lead to death of trees from girdling by rodents, which is a much greater economic loss. Thus, this project sought to address an important challenge for organic orchardists in the state and provide a better understanding of the net economic effect of different orchard floor management systems such that growers could make more informed decisions and improve their financial stability.

PROJECT APPROACH

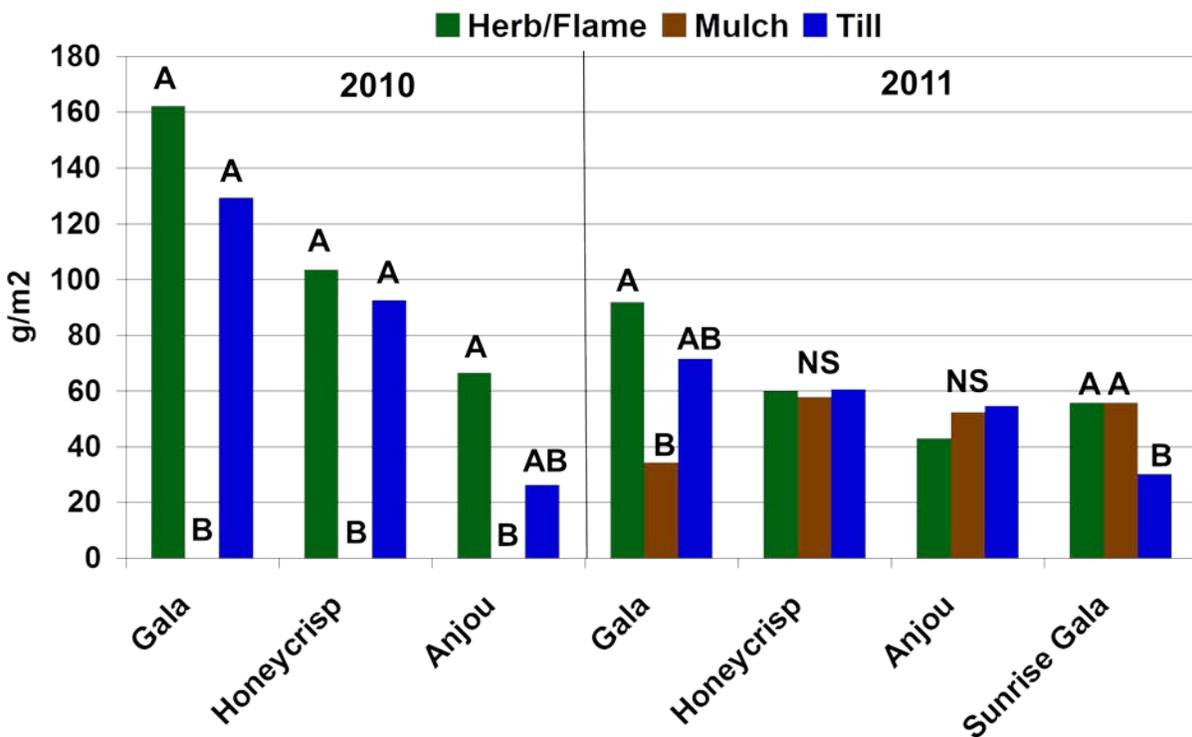
The project approach was built around the use of large-scale on-farm research on commercial organic orchards. Three field trials were set up on three different orchards owned by the Foreman Land and Fruit Co., who was the main project collaborator with Washington State University. The orchards used were: 1) Vantage Orchard, Royal Slope, WA, 6-yr old ‘Gala’/M.26 apples, sandy sloping soil, certified organic since 2006; 2) Sundown Orchard, Omak, WA, 4-yr old ‘Honeycrisp’/EMLA.26 apples interplanted in an established ‘Red Delicious’ orchard, flat silt loam soil, certified organic since 2008; and 3) Pine Creek Pears, Tonasket, WA, mature ‘d’Anjou’/ OHxF97 pears, generally flat silt loam soil, certified organic since 2008. The same three treatments were used at each site: 1) tillage (with Wonder Weeder), considered the standard; 2) organic herbicide [combination of WeedPharm (Pharm Solutions, Inc., Port Townsend, WA) 20% acetic acid at 12 gal/applied acre; citric acid at 16 lb/applied acre; horticultural oil at 2 gal/applied acre; with 16 gal water] and/or flame weeding; and 3) wood chip mulch over a weed barrier fabric (non-woven landscape fabric, Geotech South, Macon, GA). Each treatment was replicated 4 times at each site in large-scale plots (plot size varied with the site; for example, plots were ~0.7 ac each at Vantage). Treatments were first applied to Vantage and Pine Creek during August 2009, and to Sundown in late fall 2009 and early the next spring. In addition, a separate trial was established in April 2010 at the WSU Sunrise research orchard near Rock Island, WA, as a parallel trial. In addition to tillage and herbicide/flame weeding treatments, the Sunrise trial had separate wood chip and weed fabric mulch

treatments, and used small plots of 10 trees each, with 5 replications. Data from Sunrise were collected from 2010-2012.

Key activities and results for different aspects of the project are described below, with reference to previously submitted reports that contain more extensive data.

Weeds. Weeds were measured at several times during each growing season (Figure 1). Both Vantage and Sundown sites were infested with quackgrass (*Agropyron repens*), a difficult to control perennial grass weed. The mulch system was more successful in controlling this weed than the other two systems. However, the weed fabric put underneath the wood chips, while not typically combined for commercial use, was installed at all sites (except Sunrise) to specifically address the quackgrass problem. While the addition of fabric helped with weed control in the first year or two, over time the quackgrass roots expanded beyond the soil into the wood chips where they thrived. In addition, at Vantage, voles became very active under the fabric (in contrast to very little vole activity normally found in wood chips alone) and damaged many of the tree trunks, which impaired tree performance by damaging the cambium layer. Neither the tillage nor herbicide/flaming was very successful in reducing the quackgrass infestation. The herbicide and flaming provided similar control, but the cost of the herbicide was over \$1000/acre in 2010 compared to less than \$100/acre for flaming. Thus, during 2011 (and 2012 at Sunrise) only flaming was used in the herbicide/flame treatment at all sites.

Figure 1. Total weed biomass in tree row in mid-June to mid-July 2010 and 2011 for 3 commercial organic orchards (Vantage=Gala, Sundown=Honeycrisp, and Pine Creek=d'Anjou) and in 2011 for WSU Sunrise.



Voies. As mentioned above, voles were present under the wood chip mulch over weed fabric treatment at Vantage; and they damaged many trees during winter 2009/10. The majority of trees at Sundown were damaged by voles during winter 2010/11 regardless of treatment, and extensive in-arch grafting was done

to attempt to save the trees. This damage greatly impacted tree performance at Sundown, rendering the yield and growth data of little use. Voles were not a problem at Pine Creek on the large, older pear trees. Some vole activity was evident at Sunrise, which was higher under the weed fabric but absent in the wood chip mulch treatment. However, little tree damage was sustained at Sunrise, even in the weed fabric treatment.

Tree growth. The best indicator of tree growth is percent increase in trunk cross-sectional area (TCSA), since it removes the variability due to different sizes of trees at the beginning of the trial. Initial measurements were made in late June and early July 2009 at the three Foreman orchards and in March 2010 at WSU Sunrise. The two-year growth (2010-2011) is reported below (Table 1) since some of Sundown did not get treatments applied in 2009. When the three Foreman orchards are analyzed together, there is no separation of treatments for % increase in TCSA (Table 1). Mulch plots tended to have greater growth at Vantage and Sunrise, but not the other two orchards. At WSU Sunrise, there were no significant differences among treatments for tree growth in 2010 and 2011, although trees in the mulch and herbicide/flame plots tended to grow more than trees in the tillage and weed fabric plots. Only in 2012 were these differences significant ($p=0.01$) at Sunrise, with mulch 25.8a, herbicide/flame 23.6ab, tillage 21.4bc, and fabric 18.7c (values are % increase in TCSA). This is interesting in light of the yield results in 2012 where the fabric treatment had significantly greater fruit yield and fruit number than the other treatments, despite their lower vigor. These growth results provide mixed support for the initial hypothesis that tilled trees would grow less than mulched trees due to root pruning, with herbicide/burn plots falling between these two treatments. The cause of the growth reduction with fabric is unknown, but could be due in part to soil temperatures under the black fabric during summer which exceeded a reported optimal level for M.9 rootstocks (Skroch and Schribbs, 1986).

Table 1. Cumulative* tree growth (% increase in TCSA).

Treatment	All Foreman orchards	Vantage	Pine Creek	Sundown	WSU Sunrise
Mulch	26.7	26.9 a	10.1	44.9	124.9 a
Herb/flame	31.6	22.6 ab	11.3	60.9	109.2 ab
Tillage	24.8	21.8 b	7.8	43.2	99.8 b
Weed fabric	--	--	--	--	97.3 b
P=	0.16	0.05	0.23	0.24	0.05

*2 yr for Foreman orchards, 3 yr for WSU orchard project personnel also monitored tree leaf nitrogen from samples taken in late July as an indicator of tree nitrogen supply (Table 2). There were some significant treatment effects but the pattern was not consistent from site to site or among years. Most levels were at or above the range for sufficiency regardless of treatment. In 2011 at Vantage, N levels were at the lower concentration for sufficiency, which may have contributed to their lower yields. At Sunrise, mulch plots tended to have lower tree leaf N than other treatments (likely due to some N immobilization by the mulch), which has the potential to influence fruit quality. However, no significant differences in fruit quality were detected at Sunrise.

Table 2. Tree leaf total N.

	Vantage		Pine Creek		Sundown		Sunrise		
	2010	2011	2010	2011	2010	2011	2010	2011	2012
<u>Treatment</u>	----- Total N (%) -----								
Herbicide	2.32 b	1.91	1.99	1.91 b	2.66	2.60 a	2.40 a	2.46 ab	2.34 b
Tillage	2.34 b	2.00	2.08	1.97	2.71	2.21	2.43 a	2.57 a	2.56 a

				a		b			
Wood chip	2.39 a	2.04	2.00	1.82 c	2.51	2.62 a	2.27 b	2.32 b	2.26 b
Weed fabric	--	--	--	--	--	--	2.37 a	2.49 a	2.50 a
<i>p</i> =	0.012	0.24	0.281	0.002	0.562	0.01	0.017	0.02	<0.001

Fruit Yield and Size. At harvest, all the fruit from 5 trees in each plot at Vantage and Pine Creek and 10 trees per plot at Sundown and Sunrise were picked, counted and weighed to get individual tree yield, fruit number, and average fruit weight. At Vantage and Pine Creek, commercial bin harvest was done for each plot, with each group of bins per plot labeled and packed individually and run over a commercial grading line (Table 3). Thus, real world pack-out data on full row samples were generated for Vantage and Pine Creek orchards. This was not possible at Sundown due to the very limited fruit yield (often less than 1 bin per plot). Instead, bins were counted in the field to estimate fruit yields at Sundown. Based on pack-out data, yields per acre were similar in both 2010 and 2011 at Pine Creek. Although there were no treatment effects in 2010 at Pine Creek, in 2011 mulch plots had significantly greater yields than tillage plots. At Vantage, mulch plots tended to yield higher than tillage for 2009 and 2010, and were significantly greater ($p=0.01$) than both of the other treatments in 2011. There were no differences in yields at Sundown.

Table 3. Fruit yield (bins/acre).

	2009	2010	2011
<i>Vantage</i>			
Mulch	16.7	41.4	44.2 a
Herb/flame	14.8	34.0	28.0 b
Tillage	11.8	30.5	26.4 b
<i>p</i> =	0.08	0.07	0.02
<i>Pine Creek</i>			
Mulch		36.2	40.8 a
Herb/flame		31.1	36.3 ab
Tillage		39.3	34.8 b
<i>p</i> =		0.20	0.04
<i>Sundown</i>			
Mulch		3.4	2.2
Herb/flame		4.4	1.8
Tillage		3.8	2.7
<i>p</i> =		0.52	0.42

No clear trend emerged for treatment effects on fruit size. At Vantage there was no effect in 2009 or 2011, but significantly larger fruit size from the mulch treatment ($p=0.04$) in 2010, with nearly double the percentage of fruit in the target sizes of 80 and 88. There were no clear treatment effects on fruit size at Pine Creek or Sundown. Tillage plots did have slightly more fruit in the larger box sizes at Pine Creek in 2011.

At WSU Sunrise, the treatments had no significant effect on fruit yield or size in 2010, although the weed fabric plots trended higher for yield. In 2011, there were no yield differences but fabric and woodchip mulch plots had significantly larger fruit than tillage plots. In 2012, fabric plots yielded more than any of the other treatments, while woodchip mulch plots had the largest fruit size. Fabric plots had the highest number of fruit per tree while woodchip mulch plots had the lowest.

Table 4. Fruit yield and size at WSU Sunrise.

	Fruit yield (kg/tree)			Cum. yield (kg/tree)	Ave Fruit Wt. (g)		
	2010	2011	2012	2010-2012	2010	2011	2012
Mulch	11.8	8.8	10.5 b	31.0 b	157.4	199.6 a	187.7 a
Herb/flame	13.2	8.8	10.1 b	32.1 b	156.8	189.4 ab	179.4 ab
Till	16.3	7.9	11.8 b	36.1 ab	159.6	184.2 b	169.4 b
Weed fabric	22.1	8.8	15.1 a	46.0 a	152.2	201.6 a	172.2 b
<i>p</i> =	0.24	0.63	0.008 3	0.054	0.82	0.042	0.042

Fruit Quality. Fruit were analyzed for standard quality parameters (firmness, soluble solids, and starch), as well as skin and flesh phenolics, for all orchards and years except Pine Creek pears in 2010 because the fruit deteriorated in storage. Also, the 2012 ‘Gala’ apples from WSU Sunrise were not analyzed for phenolics because of the few phenolics’ differences measured in the previous years’ samples. There were very few treatment effects at any site or in any year. The ‘Honeycrisp’ at Sundown had more skin phenolics in 2011 than the ‘Gala’ at Vantage, but not in 2010. This is most likely just a cultivar difference between ‘Honeycrisp’ and ‘Gala’. At WSU Sunrise, both skin and flesh phenolics were higher in 2010 than in 2011 when maturity was less advanced. The only significant treatment effects were:

- Skin phenolics in the pears in 2011, where tillage had more phenolics than herbicide.
- Soluble solids at WSU Sunrise in 2011, where tillage had more soluble solids than herbicide.
- Firmness at WSU Sunrise in 2012, where the herbicide and woodchip mulch treatments were firmer than the fabric mulch treatment.

We had speculated that the wood chip mulch might impact fruit quality since it did impact general tree performance. If it had positively impacted fruit quality, that would have been another benefit from this management system. Nevertheless, the fact that there were few differences in fruit quality among the treatments and where differences occurred they were inconsistent over time, suggests that none of these weed control management systems negatively impacted fruit quality.

Soil and Tree water Status. The different treatments were expected to have different impacts on soil and tree water status, which could influence tree performance and fruit yield and size. Soil moisture was monitored several times during each season with a portable TDR probe (0-20 cm depth), and on some dates also with a portable tensiometer. Tillage usually causes pruning of shallow tree roots, which could compromise water uptake if irrigation applications are not closely monitored, while mulching generally preserves soil moisture potentially lowering tree water stress. Project personnel attempted to take soil moisture measurements on the day before a scheduled irrigation so the soil would be in its driest state. Mulch plots tended to be wetter, and tilled plots drier, across the season, but differences were often not large enough to be statistically significant. To look directly at tree water stress, midday stem water potential was measured with a pressure bomb at all 4 sites in 2010, at Vantage and Sunrise in 2011, and only at Sunrise in 2012. There were no differences in stem water potential at Vantage and Sundown in 2010, while mulched trees at Pine Creek had significantly less water stress than the other treatments (surprising for large, older trees). At Sunrise, tilled plots had significantly greater water stress than the other treatments (i.e. woodchip mulch, fabric mulch, and herbicide/flame) in 2010, and the pattern was similar for soil moisture. In 2011, mulch plots at Sunrise had significantly lower water stress than the other treatments (which were not different). In 2012 at Sunrise, a mini-trial was conducted on some untilled trees by imposing 4 treatments in early August during hot weather: 1) no tillage; 2) tillage on one side of the tree row (3 cm depth); 3) tillage on both sides of the tree row (3 cm depth); and 4) tillage on both sides of the tree row (1.5 cm depth). The goal was to see whether there was an immediate effect of tillage via root pruning that would induce tree water stress and perhaps explain the differences between

2010 and 2011 results. However, there were no differences in tree water stress measured over a 10-day period in this experiment, suggesting that deeper roots may be more critical to water uptake during the summer, at least for 4-6 year-old M.9 rootstocks growing in a lighter textured soil.

Soil organic matter. Soil samples for a complete analysis (0-30 cm depth) were taken from each plot of the three Foreman orchards prior to treatment application (July 2009) and then again in October 2011. In addition, shallow samples (0-5 cm and 5-10 cm depth) were taken initially and in October 2010 and October 2011 for analysis of particulate organic matter carbon (POM-C), a measure that may detect soil carbon changes sooner than some other tests. The Vantage site had the poorest soil, with a strong gradient of poorer soil going up slope. Sundown and Pine Creek had silt loam soils with higher organic matter than Vantage. Overall, there were no clear patterns of change in soil C. Project personnel had hypothesized that tillage would reduce soil C while mulch would increase it. This was not the pattern observed in the commercial orchards; in fact, soil C in mulch plots tended to decrease over the project period. This may be in part due to the sampling protocol that removed the mulch down to mineral soil, omitting the carbon-enriched top layer, and sampling down to 30 cm. In the final WSU Sunrise soil sampling in October 2012, 2.5 yr after treatment application began, there was significantly greater organic matter (0-15 cm depth) with wood chip mulch than for tillage or weed fabric (Table 4). Although not statistically significant, there was a similar pattern of the woodchip mulch having the highest total soil N and cation exchange capacity. These results indicate the positive effects that woodchip mulch has on soil quality.

The POM-C tests did not reveal any consistent trends for increasing or decreasing organic matter due to treatment. The only site with a treatment effect was at Vantage, where tillage POM-C (0-5 cm depth) was greater than mulch. The POM-C data suggest that tillage can increase active C in the top 5cm of soil with residue incorporation, but the active root systems in herbicide/burn led to greater POM-C at 5-10cm depth. These differences, plus the lack of response to mulching, point to the need for better sampling methodologies to track soil C changes under such contrasting management systems in order to understand whether levels are changing. It was surprising to see a significant change in soil organic matter (related to total soil C) and not in the POM-C fraction, which is generally considered an early indicator of total C change.

There were few other changes in soil constituents due to treatment. One was an increase in soil K (mg/kg soil) with the mulch compared to the other treatments (mulch, 213a; herb/flame, 192ab; tillage 166b; $p=0.006$), with a similar effect on soil B.

Table 4. Soil quality parameters at WSU Sunrise, October 2012 (0-15 cm depth).

Treatment	Soil Organic Matter (%)	Total N (mg/kg soil)	Cation Exchange Capacity (meq/100g)
Woodchip mulch	2.38 a	1245	5.56
Herbicide/burn	2.08 ab	1113	5.02
Tillage	2.02 b	1085	4.90
Weed fabric	1.88 b	960	4.38
P=	0.05	0.20	0.31

Financial analysis. At Vantage and Pine Creek, the fruit in each plot and each repetition was separately packed and sold so that the actual revenue could be assessed. The costs of each plot and repetition was likewise tracked and estimated for each year. Because the plots were otherwise treated identically the costs differ only in the orchard floor management costs. The revenue difference can therefore be associated with the difference in cost and any difference in yield and packout. Both Vantage and Pine

Creek achieved statistically significant differences for yields and total revenue that provides a basis to assess which orchard floor investment was the most profitable.

Tillage is used as the baseline orchard floor management technique as it is currently the most common in the industry. The cost of tillage is reasonable, about \$128 per acre per year for six passes through the orchard (Table 5). One third of this cost is associated with incremental equipment required, specifically the WonderWeeder (Harris Mfg., Burbank, WA) and a front three-point lift required for the WonderWeeder. The other two thirds are from the direct operating costs, including fuel, labor and the cost of the tractor.

Table 5 - Cost of Tillage

(a)	Tillage Capex	\$ 11,700
(b)	Useful Life (yrs)	7
(c)	Weighted cost of capital	10%
(d) =pmt[(c),(b),(a)]	Equipment cost/yr	\$ 2,403
(e)	Typical Acreage	50
(f) =(d) / (e)	Equip. Cost/ac	\$ 48.06
(g)	Tractor deisel/hr/hp (gal)	0.07
(h)	Tractor power used (hp)	25
(i)	Diesel cost (\$/gal)	\$ 4.12
(j) =(g)*(h)*(i)	Fuel cost per hour	\$ 7.21
(k)	Tractor rent/hour	\$ 9.00
(l)	Labor cost/hr	\$ 13.00
(T) =(j)+(k)+(l)	Tractor Op. Cost/hr	\$ 29.21
(n)	Tillage Speed (mph)	2.50
(o)	Miles per acre	1.14
(p) =(n) / (o)	acres per hour	2.20
(q) =(T) / (p)	Cost per acre	\$ 13.28
(r)	Passes per year	6
(s) =(r)*(q) + (f)	Tillage cost/acre	\$ 128

Table 6 - Cost of Mulch (3ft wide, 4in thick in treerow)

(a)	Treerow spacing (ft)	14
(b)	Square feet / acre	43,560
(c) = (b) / (a)	Linear feet per acre	3,111
(d)	Mulch strip width (ft)	3
(e)	Mulch thickness (in)	4
(f) = (c/3)*(d/3)*(e/36)	Cubic yards required	115
(g)	Cost per yard	\$ -
(h)	Cost/yd for hauling	\$ 8.00
(i)	Yards per acre	112
(j) = [(g)+(h)]*(i)	Material cost/acre	\$ 896
(k)	Spreader rent/hr	\$ 20.00
(l)	Yards per load	6
(m)	Loads applied/hr	3
(n) = [(k)+(T)]*(i)/(l)/(m)	Application cost/ac	\$ 306.20
(o) = (j)+(n)	Mulch cost per acre	\$ 1,202.20

Mulch is a one-time exercise that cost \$1,202.20 per acre, nearly ten times the annual cost of tillage. In previous trials, mulch has provided weed control from 2-4 years, and likely provides growth benefits beyond that. As illustrated in Table 6, application was 4 inches thick and 3 feet wide along the tree row. The mulch material itself represented three quarters of the cost. In this study, the material was obtained from a source at no charge but had to be hauled 60 miles. If material had been closer, this cost would have been less. One quarter of the cost was incurred from the application of such a large amount of bulk material using a rented Whatcom Spreader.

Table 7 - Cost of Organic Weed Spray

(a)	Speed (mph)	2.00
(b)	Miles per acre	1.14
(c)	Acres per hour	1.76
(d)	Water (gal/ac)	16
(e)	Vinegar gal/ac	12
(f)	Vnegar cost (\$/gal)	\$ 6.00
(g)	Hort.oil gal/ac	2
(h)	Hort.oil cost (\$/gal)	\$ 6.00
(i)	Citric acid lbs/ac	16
(j)	Citric acid cost (\$/lb)	\$ 1.50
(k) = (e)*(f)+(g)*(h)+(i)*(j)	Material cost / pass	\$108.00
(l) = (k) + (T)/(c)	Total cost per pass	\$124.60
(m)	Number of passes	4
(n)	Weedspray cost/yr	\$498.39

Organic Weed Spray costs were \$498.39 per acre when the rate and concentration was raised to levels that were effective for weed control. Initially, lower rates of WeedPharm (20% acetic acid), citric acid and oil were used, but they were not effective and the treatment was changed to the maximum allowable rates. A low volume Enviromist weed sprayer was purchased to see if that could help the economics by running lower rates of material. High concentrations at low rates were more effective than low concentrations at high rates, however results were still insufficient to provide any meaningful control. Additionally, the acidic solution quickly destroyed the Enviromist sprayer. Consequently the only way to

achieve any sort of control was through the use of large quantities of spray material. Other organic compliant herbicide materials were tried as well, including GreenMatch and Burnout Organic Herbicide. GreenMatch at higher rates was effective (data not shown) but it was more costly than the vinegar/citric/oil solution. Weed control with organic herbicide was expensive.

Table 8 - Cost of Flaming

(a)	Flaming Capex	\$	2,500
(b)	Useful Life (yrs)		7
(c)	Weighted cost of capital		10%
(d) =pmt[(c),(b),(a)]	Equipment cost/yr	\$	514
(e)	Typical Acreage		50
(f) =(d) / (e)	Equip. Cost/ac	\$	10.27
(g)	Speed (mph)		5.00
(h)	Miles per acre		1.14
(i) =(g) / (h)	Acres per hour		4.40
(j)	Propane cost/ac	\$	14.00
(k) =(T) / (i) + (j)	Cost /acre/pass	\$	20.64
(l)	Passes per year		5
(m) =(k)*(l)+(f)	Cost per year	\$	113.46

Flaming costs were comparable with tillage costs and control was achieved with fewer passes (Table 8). Results were generally better than what was achieved with the organic weed spray and so for the part of the second year and all of the third year flaming was used for the Herbicide/burn treatment. It was also employed on the mulch because weeds began to grow from the mulch in the second year. Most of the cost of flaming is from the cost of the propane used. Travel through the orchard is at higher speeds when flaming than it is for tillage or weed spray.

Table 9a - Vantage Orchard Production Value from 2009 - 2011

	Bins / acre			Revenue/bin (\$)			Revenue / acre (\$)		
	2009	2010	2011	2009	2010	2011	2009	2010	2011
	(a)	(b)	(c)	(d)	(e)	(f)	(g)=(a)*(d)	(h)=(b)*(e)	(i)=(c)*(f)
Mulch	17	41	44	233	229	377	3,891	9,481	16,643
Herb/flame	15	34	28	231	229	375	3,419	7,769	10,496
Tillage	12	31	26	227	227	371	2,679	6,924	9,798

Table 9b - Vantage Orchard Net Present Value of Orchard Floor Treatments

Treatment cost			3-year Net Present Value (n)=NPV(m,o;q)	Weighted cost of capital (m): 10%		
2009	2010	2011		Revenue less orchard floor costs		
(j)	(k)	(l)		(o)=(g)+(j)	(p)=(h)+(k)	(q)=(i)+(l)
(1,202)	(113)	113	\$7,574	2,689	9,367	16,757
(498)	(113)	(113)	\$1,581	2,920	7,656	10,383
(128)	(128)	(128)	\$0	2,551	6,796	9,671

Vantage Orchard Economics. At Vantage Orchard, the fruit production of the mulch plots rose each year while the production of the other plots rose and then fell (Table 3). The most marked difference was in the third year when the mulch treated rows had much higher production. The revenue per bin was not statistically different. The revenue was statistically higher for the mulch treated rows (Table 9a). Table 9b illustrates that the high cost of mulching the orchard incurred was greatly exceeded by the increased revenues in the subsequent three years. The future benefit was reduced to reflect the time value of money, risk and opportunity using a cost of capital of 10%. Column (n) in Table 9b shows the present value of these future benefits normalized to the present value of the Tillage plots. The mulch had a benefit of \$7,574 relative to that of the tillage. This present value is large because the magnitude of the revenue benefit greatly exceeds the cost of the mulch. Few actions in the orchard result in economic benefit of this magnitude. The economic benefit of the mulch is likely underestimated because its benefits are likely to last beyond the third year into the fourth, fifth, sixth, and perhaps seventh year. The magnitude of this future benefit cannot be quantified however due to the study duration being three years. The benefit of herbicide/flaming while positive on average was not statistically different from tillage. Flaming and tillage produced similar outcomes.

Table 10a - Pienecreek Orchard Production Value from 2010 - 2011

	<u>Bins / acre</u>		<u>Revenue/bin (\$)</u>		<u>Revenue / acre (\$)</u>	
	<u>2010</u>	<u>2011</u>	<u>2010</u>	<u>2011</u>	<u>2010</u>	<u>2011</u>
	(a)	(b)	(c)	(d)	(e)=(a)*(c)	(f)=(b)*(d)
Mulch	36.2	40.8	370	251	13,394	10,242
Herb/flame	31.1	36.3	363	246	11,289	8,933
Tillage	33.3	34.8	357	260	11,888	9,033

Table 10b - Pinecreek Orchard Net Present Value of Orchard Floor Treatments

<u>Treatment cost</u>		<u>3-year Net</u>	<u>Weighted cost of capital (i): 10%</u>	
<u>2010</u>	<u>2011</u>	<u>Present Value</u>	<u>Revenue less orchard floor costs</u>	
(g)	(h)	(j)=NPV(i,o;q)	(k)=(e)+(g)	(l)=(f)+(h)
(1,202)	(113)	\$1,403	12,192	10,129
(498)	(113)	(\$952)	10,791	8,820
(128)	(128)	\$0	11,760	8,905

Table 10b shows the moderate differences in revenue and net present value for the three treatments at Pine Creek. However, the differences in revenue are not statistically different. The effect is not large enough to overcome the inherent noise resulting from variability within the orchard. The magnitude of the revenue difference across treatments was much less than what was measured at Vantage. A trial that covers a much larger section of the Pine Creek orchard than the 10-acre trial used might tease out an effect, if there is one. It is possible also that if the study was continued for a longer duration, an effect may emerge, but what is certain is that the effect is much smaller than what was experienced at Vantage Orchard. The reasons for this are discussed later, but is likely to be primarily a result of soil differences and tree size differences.

David Granatstein provided overall project leadership and coordination. He and his staff did the field data collection and managed the plots at WSU Sunrise. They did the field data entry and statistical analysis on these data. Granatstein also shared project findings with grower stakeholders at industry meetings. Alan Groff organized the sites and field management on the three Foreman Orchards. He arranged for the appropriate management to be done on the different plots, monitored the performance of the different systems and made adjustments, set up the large scale commercial harvest logistics and separate fruit packing for each plot to generate replicated pack-out and economic data, documented

practical aspects (pro and con) of the different systems, and conducted the economic analysis. Preston Andrews assisted with field data collection and supervision of the graduate student (first season), conducted all fruit quality analysis in his lab, and statistically analyzed fruit quality data. He also worked with Granatstein and Groff on needed management adjustments and project decisions, and contributed to outreach via posters at several industry events. David Granatstein authored the quarterly and annual reports, with Andrews and Groff contributing to and editing them.

GOALS AND OUTCOMES ACHIEVED

The project had four outcomes that could be achieved during the project period and one long-term outcome that will not occur for some time after project completion.

Tree performance (statistically greater tree growth, fruit yield, fruit size, and less alternate bearing issues). Mulch trees tended to grow more than tilled trees at two sites, with statistically greater growth in some cases. The results were not as clear as we might have expected. Mulch trees tended to have higher fruit yields at some sites (statistically significant in some cases), while there was no consistent effect on fruit size. Fruit size at WSU Sunrise was consistently less than 200g, a threshold size to be above to receive the best prices. There was no evidence that the treatments influenced alternate bearing tendency at the three commercial orchards.

Soil sustainability (a statistical increase in soil organic matter [total C, Particulate Organic Matter C]). The most meaningful change in soil organic matter, a key indicator of soil quality, was seen at WSU Sunrise. Mulch plots had significantly greater soil organic matter than tilled plots, but neither tillage nor mulch plots were significantly different from herbicide/burn plots. This approximated the original hypothesis of mulch increasing organic matter and tillage decreasing it relative to a bare ground undisturbed soil (the goal for the herbicide/flame system). The detected difference at Sunrise may have been due to the smaller depth increment of sampling (0-15 cm soil at Sunrise vs 0-30 cm in the commercial orchards). For this outcome, there was neither an increase nor decrease in soil carbon tied to treatment during the two years of monitoring at the three commercial orchards even though the results at WSU Sunrise did support the original hypothesis of decreased soil quality from tillage. Thus, use of tillage for weed control did not pose a risk for loss of organic certification due to decreasing soil quality in the commercial orchards, but it did at WSU Sunrise.

Fruit quality (a statistical improvement in standard fruit quality measures and/or nutritional quality). There were only two cases of significant differences in fruit quality due to treatment. Thus, orchard floor management did not impact the economics of the orchard via an effect on fruit quality, either positive or negative. While unexpected, this outcome is encouraging in that any of these weed control systems appear to be similar with respect to fruit quality.

Profitability (equal or increased net three year return and net present value for the alternative systems compared to the tilled system; lower costs for external soil amendment inputs; no major barriers to adoption of alternatives [e.g., increased voles]). At Vantage, the economic benefit of the mulch exceeded that of tillage by \$7,574 per acre. This must be weighed against the risk of vole damage, which occurred at Vantage, but was not enough to prevent the economic benefit. Nonetheless, the experience at Sundown, with young trees, stands as a warning of greater risk of vole damage. The economics of herbicide/flaming treatment was in no case statistically worse or better than that of tillage showing that it is a very viable orchard floor management strategy that avoids the downsides of soil degradation and root disruption. Organic herbicides were much more expensive than flaming and would not be economical. A hybrid of the two could be used, where tillage is employed at the end of the season to disrupt rodent habitat.

The one long-term outcome for the project was **Grower Adoption** (increased number of growers using either alternative system that proves superior to tillage, based on surveys at the winter industry horticulture meetings). Project results did not point to a clearly superior orchard floor management system. Mulch appears to have potential to improve tree performance, but this is probably most likely to occur on sandy or shallow soils. Organic herbicides were no better than flame weeding and tremendously more expensive. So, this study's results would discourage growers from relying on those materials. Flaming and tillage are both relatively low cost compared to mulching. Again, while the data were not compelling, tillage plots tended to perform less well than the undisturbed herbicide/flame plots. This might be due to a negative effect from a combination of root pruning and greater soil evaporation, for which there was evidence at WSU Sunrise in the first year of the trial (greater tree and soil water stress), but this was not repeated in subsequent years. It could be that any adverse effects from root pruning by tillage are compensated for in subsequent years. In addition, the stress from root pruning was not enough to induce any effects on fruit yield, size, or tree growth. Tilled plots at Sunrise did show the potential for a reduction in soil organic matter. Some growers commonly use several practices, such as spring and fall tillage with mid-summer flaming and mowing. This project did not test such combinations, although it is probably desirable to use a variety of weed control methods over the season. While there appears to be a benefit from mulching, a 4-6" layer of mulch was used in this study in order to effectively control weeds. This requires large quantities of mulch and the expense of transporting and applying it. If a thinner layer of mulch could deliver the desired growth benefits for the trees, but be combined with other practices (e.g. flaming) to control weeds, growers might be more able to afford the initial cost of mulching. And suitable mulching materials are not necessarily widely available, thus lower rates would stretch constrained supplies. The wood chips have generally not incited vole problems, while most other mulch materials, including fabric, have. A combination of wood chip mulch on top of fabric aggravates rodent damage, especially if their populations are high.

The primary hypothesis for the project was that tillage damages tree feeder roots responsible for water and nutrient uptake and destroys organic matter, which reduces water- and nutrient-holding capacity of the soil. The consequence of these effects would be impaired tree health and performance, lower revenues from reduced yields and smaller fruit size and higher costs because of the necessity for additional inputs of organic amendments to rebuild soil organic matter. The alternative systems used in the project were chosen to eliminate soil disturbance. Previous research suggested that these weed control alternatives can enhance soil quality and tree root health while lowering fertilizer cost. Research conducted in past decades demonstrated that the herbicide strip-grass alley system plus conventional fertilizer was the lowest cost and highest profit approach, despite the fact that in more than 10 published studies, mulching the tree row led to superior tree performance. However, the improved performance of using mulch in the tree row shown by these studies did not justify the added cost of mulch. The constraints of organic farming systems (i.e. expensive fertilizers and poorly effective herbicides) may change the profit equation and challenge conventional wisdom, and thus informed the project design. The goal was to test three contrasting orchard floor management systems at field scale in commercial organic orchards to determine whether the hypothesis was correct, and whether a superior system would become evident.

During the course of the project, project personnel performed all the field practices and data collection that were outlined as necessary to test the hypothesis and evaluate the systems. However, as in all science, the outcome of the research is not predictable or guaranteed to conform to the results that were expected. Rather than the outcomes of the study proving clearly that tillage is detrimental and mulch is superior, the project did generate evidence that mulch can improve tree performance and in some situations this can result in a net improvement in profitability. Tillage did not lead to obviously or consistently poorer tree performance or soil degradation, but these negative outcomes did occur in some instances and thus confirm the caution that repeated tillage for weed control should be avoided. The clearest result was that in the herbicide/flaming treatment, intended to eliminate soil disturbance while

still providing weed control, the available organic herbicides were no more effective than flaming, but cost much more. None of the treatments led to consistent changes in fruit quality, another factor that could influence profitability. The project results did largely disprove the hypothesis that tillage would necessarily lead to a series of negative outcomes (poorer tree growth, smaller fruit size, declining soil organic matter), but these outcomes do remain a risk if tillage is used indiscriminately.

Tree performance. Tree trunk cross-sectional area (TCSA) was measured at the beginning of the study, and each fall, to enable calculation of this accepted measure of tree growth. The commercial orchards were monitored for 2.5 growing seasons and WSU Sunrise for 3 seasons. Fruit yield and size were measured both with a small sample (5 trees per plot at Vantage and 10 trees per plot at the other sites) as well as commercial bin harvest by plot at Vantage and Pine Creek. The mulched trees tended to produce greater tree growth and higher yields, but there was no clear trend for fruit size. There was no evidence of treatment effect on alternate bearing.

Soil sustainability. There were no significant trends in soil C, either as total C or POM-C (an early indicator of change) other than the treatment differences at WSU Sunrise. Total C (0-30 cm depth) at both Vantage and Pine Creek declined slightly over the course of the project and increased slightly at Sundown, where there was a significant treatment effect. The herbicide/flame plots tended to have the highest total C, perhaps due to C contributions from the active root systems of the weeds and/or C from charred vegetation on the surface after flaming. However, this was not supported by the surface POM-C data at that site. There was a significant treatment effect on POM-C only for 2010 at Vantage, where tillage was higher than mulch. Only at Sunrise was there a treatment separation for soil C, a key component of soil quality mandated by the National Organic Program.

Fruit quality. Standard fruit quality as well as fruit phenolics (an indicator of antioxidant content) were measured but the results did not show any meaningful effect of orchard floor treatment. Results did differ by site and year. Therefore, treatments did not have a negative impact on economics based on differences in fruit quality that could affect fruit value.

Profitability. Mulch provided a large economic benefit at Vantage Orchard. Orchards similar to Vantage, namely with soils that have low organic matter (less than 1.5%) should consider mulch as an important tool to improving organic orchard profitability. On the other hand at orchards similar to Pine Creek, with large trees and rich soils (organic matter greater than 5%), mulch is likely not going to provide sufficient economic benefits to be justified. Our results show similar profitability for herbicide/flaming and for tillage. The two techniques offer different advantages. Tillage, while it has downsides, provides the benefit of disrupting rodent habitat. Flaming provides the benefit of not disrupting soil or the roots of the trees. This is likely to be important in young orchards where trees have small shallow root systems. A hybrid of the two techniques should be considered to maximize both of these benefits.

BENEFICIARIES

By partnering with Foreman Fruit Co. for the study (Alan Groff), this project provided a commercially relevant, data driven comparison of organic orchard floor management systems. The results have benefited Foreman Fruit Co., a significant organic producer in the state, and have been shared with other growers through field days and presentations at grower meetings. There are approximately 275 growers with organic tree fruit in the state, and they can benefit from the findings by avoiding reliance on organic herbicides, using cost-effective flaming and tillage, and using mulch in targeted situations on poorer soils.

No quantitative data on any adoption of the practices being investigated were collected, as the project length was insufficient to expect that outcome in 2-3 years. The project team is aware of 1200 organic acres that have adopted the lessons from this study. Across all of these orchards tillage is now used very sparingly after harvest for the purpose of managing rodents. Mulches have been applied to weak soils;

for example, the remainder of Vantage Orchard, which is 130 acres, all received mulch. All blocks are receiving higher levels of compost each year with the goal of getting organic matter to 5% on all blocks. It is likely that more growers will follow suit given that those orchards that have adopted these practices are getting better than industry standard results.

LESSONS LEARNED

Based on the results from this project, it was not possible to firmly conclude that tillage is a less desirable orchard floor management system, as previous studies have shown. Negative results from tillage did occur but were inconsistent. This project studied large plots in commercial organic orchards to represent a real-world situation, but with proper experimental design to generate valid data. The ability to gather yield and packout data by plot (for two sites) was a valuable methodological decision and illustrates the potential shortcomings of small plots in orchards where variability from tree to tree can be very high. While the large plots may have added some variability in terms of soil type and management errors, they did provide a large harvest sample to evaluate. Two of the orchards were infested with quackgrass, a perennial weed for which there is no effective organic control in an orchard setting. The combination of wood chip mulch over fabric was successful in suppressing this weed for one season, but incited vole damage in the process. While quackgrass is not uncommon in organic orchards, it might have been useful to include a younger orchard site without such extreme weed pressure. As it was, none of the treatments provided satisfactory multi-year weed control in the quackgrass infested orchards. But this did not appear to create undo competition for nutrients with the trees based on the leaf tissue nitrogen analysis. Thus, adequate fertility and water inputs can largely compensate for weed competition. But lack of weed control does increase the risk of vole damage, which was experienced at these orchards.

Based on project results, currently available organic herbicides are not a cost-effective weed control option. They were substantially more expensive than the flame weeding with no better performance. Flame weeding at WSU Sunrise quickly selected for dandelion, which was not killed over the 3-year project despite repeated flaming. It would take a much higher frequency of flaming to reduce this weed than what was used by Foreman Fruit.

One commercial orchard was on a sandy soil, and two orchards on silt loam soils. Improvements to tree performance were more obvious on the sandy site. Foreman Fruit tested mulch on another orchard with sandy soil and observed noticeable benefits to tree performance. Had the study not been impacted by voles at Vantage and Sundown, there may have been more of a tree response to mulching. At Vantage, mulching did lead to a significant increase in size 80 and 88 fruit in 2010, often the most valuable sizes. The revenues generated from the mulch, herbicide/burn, and tillage plots for that year were \$10,497, \$ 8,434, and \$ 8,365 per acre, respectively, with per bin returns of \$233, \$231, and \$227 for the respective treatments. Commercial pricing was relatively flat on the peak sizes and thus the fruit size impact was more related to volume (i.e. yield) than price. At Vantage, with current fruit prices of approximately \$400 per bin, it would only take 3-4 bins to cover the added cost of mulching, and mulch increased yields more than this in both 2010 and 2011.

The large-scale on-farm trials were complemented by the smaller, more controlled parallel study at the WSU Sunrise research orchard. In part this was intended to provide a more stable data source for the graduate student on the project. These plots were useful for some of the additional intensive monitoring and several satellite studies. However, fruit yield variability was quite high, as was overall tree-to-tree variability, so the results were less striking than anticipated, even using 5 replications.

At the end of this study, project findings can be summarized into the following two key conclusions:

- In mature orchards on fertile soils, with higher organic matter and satisfactory irrigation systems, tillage does not necessarily impair profitability, because it is lower cost and provides better rodent

control, potentially offsetting any loss of tree performance. Although surface feeder roots may be damaged the first year tillage is used, the root system appears to adjust in subsequent years.

- In orchards on dwarfing rootstocks in lighter soils and with inadequate irrigation, mulch can be more profitable. Mulch will likely improve tree performance in more situations than can be economically justified.

The biggest unexpected problem with the study was vole damage at the Vantage and Sundown orchards. A fabric material was used under the wood chip mulch because of the quackgrass infestation, not anticipating that this would provide an attractive habitat for voles. They burrowed beneath the fabric and came to the surface by the trunk where they caused significant feeding damage to the bark. The project included funding for a graduate student as part of the staffing. A parallel trial was set up at WSU Sunrise to help ensure success for the student. However, the student left after one year and her position was filled with other hired labor. With this change, the project lost the potential for an individual to delve deeper into some of the soils issues that were of interest to project staff. The monitoring of soil C changes may have been more successful had the student remained on the project. Measurements of stem water potential were conducted, an indicator of tree water stress. The most intensive work was done at WSU Sunrise. It was surprising how difficult it was to induce a change in tree water stress at this site, where the sandy loam soils were expected to dry out quickly without irrigation and for the trees to respond to the added water stress. Tillage plots at Sunrise did separate out from the other treatments for both stem water potential and soil moisture (more stress) in the first season (2010), but not in subsequent seasons (2011 or 2012). A small side study was conducted to see whether we could induce more tree water stress following various tillage regimes in mid-summer, when the effect of root pruning would be expected to be greatest. This did not occur over a 10-day study period. Thus, it was not possible to confirm the likelihood that the more negative stem water potential seen with tillage in the first year was due to root pruning or not. Nevertheless, the roots may have adapted to tillage after the first year by refocusing their growth into untilled areas of the soil profile in subsequent years.

While the data from the study did not confirm all points of our starting hypothesis, the project clearly met its goals of conducting an orchard-scale comparison, showing a number of results where mulch was beneficial but fewer results with a negative impact of tillage than anticipated. The negative effects of tillage observed in some parts of the industry may reflect the use of tillage combined with a failure to apply compensating organic amendments to the tilled soil. Vantage Orchard at one time relied completely on tillage and had an alternate bearing problem so severe that every other year it had only 20% of a crop and even in the “on” years it was operating below its potential. Even in the tillage portion of the trial, there were improvements in performance, which may have reflected greater application of compost than had been used in the past (compost was applied equally to all plots). Over time tillage reduces organic matter and without the application of imported organic matter, the orchard may reach a tipping point where nutrient holding capacity and biological properties are impaired such that the profitability declines. Determining that point was not feasible within the time frame of this study.

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ADDITIONAL INFORMATION

David Granatstein committed 5% of his time to the project as in-kind match, but provided more in terms of the actual hours involved. He provided overall project management, was responsible for much of the field data collection and analysis, and worked on the outreach. Foreman Fruit Co. provided \$81,960 in in-kind match that included additional orchard wages for the trial, salary (Alan Groff), mulch hauling and

application, and additional incremental orchard management cost to conduct the trial. They hosted the trials at three of their orchards, where they covered all normal operating costs plus much of the additional cost of having replicated plots with differing treatments. They also arranged for the commercial bin harvest at Vantage and Pine Creek and packout by plot at the fruit company, which provided much better data than small plot harvests. Alan Groff was responsible for all of the economic analysis and an assessment of grower practicality.

Andrews, P., Granatstein, D., Groff, A. 2011. Increasing profitability with organic orchard floor management alternatives. Poster presentation at Wash. St. Hort. Soc. Annual Meeting, Wenatchee, WA, Dec. 5-7, 2011.

Andrews, P., Granatstein, D., Groff, A. 2011. Increasing profitability with organic orchard floor management alternatives. Poster presentation at 2nd International Organic Fruit Symposium Leavenworth, WA, June 18-21, 2012.

Washington State University

Stem Number, Tuber Set and Size Distribution Relationships for Specialty Potatoes

PROJECT SUMMARY

This project focused on developing management techniques for modulating tuber size distribution to maximize value of selected fresh market potato cultivars. Tuber set and size distribution are closely correlated with the degree of apical dominance (stem numbers) produced by seed potatoes. As stem numbers increase, plants set more tubers, and average tuber size decreases. Since tubers are packed and marketed according to size, the size distribution profile can greatly affect crop value. Target stem number and tuber set relationships exist for every production region and market niche, where size distribution can be optimized for maximum profitability of a particular cultivar. Seed and commercial growers can potentially add value to their crops by treating seed to produce a particular tuber size distribution according to anticipated market requirements. Developing reliable methods for storage and treatment of seed potatoes to optimize tuber set and size distribution for added value was a major goal of the project.

Goals and Objectives

- (1) Develop pre-plant treatments for seed of cultivars Chieftan, Red LaSoda, Yukon Gold, Cal White, and Satina that will enable growers to effectively alter tuber set and size distribution.
- (2) Undertake a comprehensive economic analysis of different tuber size profiles to identify the target stem numbers for maximum returns using fresh and seed contract assumptions.

Potato growers are constantly looking for ways to increase the efficiency of production to enhance economic returns. Researchers in the Knowles lab at WSU have researched the physiology of tuber set along with production factors affecting tuber size distribution in potato production for many years. Controlling tuber set and size distribution can add substantial value to a crop. Fundamental and applied aspects of this research have been extended to stakeholders at various industry meetings (e.g., WA/OR Annual Potato Conference) but the focus has been primarily on long russet cultivars for the processing industry. Several years ago, Dr. Knowles was approached by commercial seed growers in WA to initiate a project to develop techniques for manipulating tuber set and size distribution in specialty cultivars produced for the fresh potato market. Hence, the initial motivation and partial support for this project came directly from industry stakeholders.

PROJECT APPROACH

This three-year project tested a number of treatments (strategies) to accomplish the objectives stated above. Treatments included accelerated aging by storing seed at temperatures greater than 4°C and use of auxin transport inhibitors, pinching agents, and gibberellins (GA) as seed treatments to decrease apical dominance. As described below, the most effective treatments were discovered and developed during years two and three of the project.

Consistent with results of preliminary studies conducted in 2008/09, cultivars Satina, Red LaSoda, Cal White, Chieftan, and Yukon Gold were highly resistant to increasing stem numbers in response to high temperature-induced age-priming treatments administered during storage in 2009/10. Hence, a different approach involving plant growth regulators was pursued in 2010/11 and 2011/12. In 2010, a number of plant growth regulators were screened for their effects on decreasing apical dominance when applied to seed directly prior to planting in April. The overriding objective was to break apical dominance so that seed-tubers produced plants with more stems, increased tuber set, and greater yields of smaller tubers without affecting market yield. Of three growth regulators tested (3-nonene-2-one, cyclanilide, GA), GA (gibberellin) at 10 ppm greatly increased stem numbers (from 3 to 5-7 stems per seedpiece, depending on cultivar), resulting in desired shifts to smaller tubers; however, GA also decreased yield and altered tuber shape (elongated tubers). These effects were likely due to the relatively high concentration (10 ppm) of

GA used in the initial studies. Accordingly, in 2011 a lower range of GA concentrations was tested to determine if apical dominance could be reduced and tuber size distribution altered without negatively affecting yield and tuber shape. It was reasoned that reduced rates of GA may result in intermediate levels of reduced apical dominance to the extremes produced with 10 ppm, thus producing a broad range of stem numbers, tuber set and size relationships for each cultivar. Seed of the five cultivars were treated with 0, 2, 4, and 8 ppm GA in 2011 to evaluate efficacy on apical dominance, tuber set, yield, tuber shape, and tuber size distribution. While 8 ppm GA was still too high, reducing tuber yield and adversely affecting tuber shape, 2-4 ppm GA greatly increased stem numbers and shifted tuber size distribution without negatively impacting yield and tuber shape. These results suggested that even lower concentrations of GA may have efficacy for manipulating tuber size distribution. Therefore, in 2012, GA was tested at 0.5, 1, 2 and 4 ppm. Stem numbers increased with GA rate, resulting in a broad range of apical dominance for each cultivar, with minimal impact on marketable yields.

As stem numbers increased with GA, tuber set per plant increased and size distributions shifted to favor higher yields of the potentially more lucrative “C” size (creamer, 10-66 g) and “B” size (67-91 g) potatoes at the expense of the larger “A” size (92-360 g) tubers (Tables 1-5). The optimum GA concentration for shifting tuber size distribution and adding value to Cal White, Chieftain, and Red LaSoda was 2-4 ppm in two years of study. Total returns from the GA-induced yield shift (and in some cases, increased yield) ranged from 4-30%, depending on cultivar, GA concentration and year. Crop value of Yukon Gold was increased by only 5% at 2 ppm GA in 2011 but increased 14% when seed was treated with 0.5 ppm GA in 2012. GA at 2-4 ppm increased total returns of Satina by 19 and 27%, respectively, in 2010 by shifting tuber size distribution and increasing marketable yield. However, a shorter growing season in 2012 resulted in variable effects on returns for Satina, which ranged from -13 to +7%, depending on GA concentration. Collectively, these results demonstrate that pre-plant treatment of seed potatoes with GA is an effective method to reduce apical dominance, increase tuber set, shift tuber size distribution to smaller grades, and increase value of the crop. Hence, the 3-year project was successful in developing a strategy to manipulate tuber size distribution for added value. Further work is needed to evaluate the interaction between GA concentration and length of growing season to fine-tune the recommendations for each cultivar.

This project did not involve researchers from other states. Cooperators included Dick Bedlington Farms and Pure Potato, LLC. The Bedlingtons (Marlys and Dick) have been instrumental in procuring high quality certified seed from specialty potato seed growers in the Lynden, WA area each fall for the project. The project also constitutes a portion of the thesis of Jacob Blauer, a PhD student under my direction in the Molecular Plant Sciences program at WSU.

GOALS AND OUTCOMES ACHIEVED

The activities undertaken to achieve the project goals are described in the Project Approach section. Expected measurable outcomes included the increased value inherent in producing a commercial crop from seed that has been treated to give a higher percentage yield in the more lucrative tuber size classes (eg. Sizes “B” and “C” grades). To date, our studies have shown that the five specialty cultivars in this study are highly resistant to accelerated aging treatments induced by brief storage periods at high temperatures. This finding is in contrast to that for most of the long russet cultivars. Management of storage temperature is thus not an option for influencing apical dominance and tuber size distribution of these fresh market specialty cultivars. Treatment of seed with GA, however, significantly increased the proportion of ‘B’ and ‘C’ size tubers without reducing marketable yields, and in several cases significantly increased marketable yields. The measurable outcome of increasing crop value with treatments designed to alter tuber size distribution was thus achieved.

The measurable outcome of developing an effective method to shift tuber size distribution to add value to the specialty potato cultivars used in this study was achieved; however, more work is needed to fine-tune the recommendations for GA concentration in relation to length of growing season and cultivar-specific

differences in tuber growth rate. Extension of the results to stakeholders will facilitate adoption of this management technology as an option for growers. The long-term economic impact will thus depend on the extent to which the technology is adopted by stakeholders.

The goal of developing an effective method for manipulating tuber size distribution in selected potato cultivars was accomplished by evaluating the effects of seventeen treatments (seed age, plant growth regulators, GA rates) in fifteen independent replicated trials conducted at WSU's Othello Research Unit during the 2010, 2011 and 2012 growing seasons. All cultivars responded favorably to low concentrations of GA, and recommendations for use of this hormone to regulate tuber size have been (and will continue to be) communicated to stakeholders.

The measurable outcomes of increasing tuber set and shifting tuber size distributions to add value were achieved by effectively decreasing apical dominance with GA treatment of seed-tubers to increase stem numbers beyond that inherent in non-treated seed of each of five specialty cultivars. The baseline data was thus the degree of apical dominance, tuber set and size distributions characterized in non-treated seed of each cultivar. Stem numbers ranged from one to three stems per plant (baseline) depending on the cultivar. GA treatment (at the appropriate concentration) increased stems to four to seven per plant, with associated shifts in tuber size distribution, without negatively affecting yield and quality (depending on concentration), resulting in increased crop values.

BENEFICIARIES

Because the project was only just completed, potato growers have not yet had an opportunity to implement the findings. However, as explained above, it is expected that extension of the results will lead to further adoption. The beneficiaries of this project will be specialty potato growers, including seed and commercial growers of fresh pack. Processors of specialty potatoes for the baby potato market (e.g., baby bakers for the retail and quick service food industry) also stand to benefit from this technology. Extension of the results has already begun. Results were reported to stakeholders at the WA/OR annual Potato Conference and Trade Show and the Western WA Potato Growers meetings January 26 and February 17, 2011, respectively. An article from the project was published in the Proceedings of the WA Potato Conference and Trade Show (Knowles NR, Blauer JM, Knowles LO. 2012. Shifting potato tuber size distribution with plant growth regulators. Proceedings of the Washington-Oregon Potato Conference, Jan 24-26, Kennewick, WA, pp 20-28.)

The economic effects of using GA to increase stem numbers, tuber set, shift tuber size distribution and/or increase marketable yields are summarized by the data in Tables 1 and 5.

LESSONS LEARNED

Offer insights into the lessons learned by project staff as a result of completing this project. Include the positive and negative results and conclusions of the project.

- Age priming by storing tubers for various periods at elevated temperatures during storage is not effective in altering apical dominance and tuber size distribution with these cultivars.
- The chemical pinching agent, 3-nonen-2-one, and the auxin transport inhibitor, cyclanilide, were also non effective.
- Pre-plant treatment of seed-tubers with GA effectively shifted tuber size distribution; however, concentration is critically important to avoid negative effects on tuber yield and shape.
- Optimal GA treatments (i.e. concentrations) need to be matched to the cultivar in relation to length of growing season.
- Target size distributions should be identified before treating and planting seed to facilitate choosing the ideal concentration of GA and length of the growing season to optimize tuber size distribution.

- Growers need to work closer with packers to identify size distribution needs.
- Returns will depend on contract prices and specific size clauses and these prices will vary with market conditions through the season. Therefore, harvest windows for each cultivar need to be closely coordinated with marketing windows where price contracts are optimal (i.e. in phase with production of specific size classes).

The insensitivity of these cultivars to high temperature age-priming treatments was surprising and has implications for handling and storage of seed. Unlike many russet cultivars, seed of the five specialty cultivars in this trial can accumulate significant heat units without affecting yield potential. Hence, moderate heat unit accumulation during wound healing in the fall, warm up in the spring, and during the cutting operation will likely have little effect on performance in the field. The apparent interaction between length of growing season and optimum GA concentration demands that recommendations for GA use be cultivar specific.

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ADDITIONAL INFORMATION

The match provided for this project totaled \$56,046.

Washington State University

Determining the benefits of cane burning to red raspberry in the Pacific Northwest

PROJECT SUMMARY

Cane burning, chemically removing the first primocanes produced by red raspberry in the spring, is commonly practiced in the Pacific Northwest. The practice was first described by scientists in Washington and Oregon in the early 1970's, and was developed to aid in the machine harvest of the predominant raspberry cultivar at the time ('Willamette') using the herbicide dinoseb. This practice is now used on approximately 95% of raspberries in Washington. The goal of this research was to determine whether cane burning current Pacific Northwest red raspberry cultivars with currently available herbicides improves berry yield as dramatically as cane burning did when it was first developed. Our research hypothesis was that cane burning is not as important as it was during its development and may be dropped from current raspberry production practices without resulting in lost yield or unacceptable losses in weed control.

This project measured the effects of cane burning herbicides in two older and three newer red raspberry cultivars ('Meeker' and 'Coho' and 'Cascade Bounty', 'Chemainus', and 'Saanich', respectively). Data generated included (1) effectiveness of five herbicides for managing primocanes; (2) injury to floricanes, including visual symptoms and berry yield; and (3) weed control. Treatments included a residual herbicide (terbacil, Sinbar) applied to dormant raspberries or cane burning products (carfentrazone (Aim), oxyfluorfen (Goal), pyraflufen (Vida), glufosinate (Rely), and saflufenacil (Treevix) applied to emerging primocanes. In off-station trials, weed control and primocane growth were monitored and those plots were machine harvested each season. In on-station trials, weed control, yield, and primocane growth were monitored as well as herbicide effects on floricane fruiting laterals (counts of flowers, fruiting sites). At the end of the season, final primocane measurements were collected and time required for pruning and training was recorded. The project was conducted from 2010 to 2012, with the same plots receiving the same treatment each year.

An estimated 95% of red raspberry producers in Washington cane burn at least once per season, depending on the health and vigor of their raspberry planting. Herbicide cost alone ranges from \$30 to \$50/acre to cane burn, translating to an estimated \$475,000 on the 9,500 acres of red raspberries harvested each year. Over a ten-year lifespan for a raspberry planting, Washington growers may spend as much as \$4.5 million on this practice. Since this project could confirm the hypothesis that cane burning certain PNW red raspberries does not significantly improve berry yield, growers of those cultivars might be able to reduce their use of these cane burning herbicides, potentially saving growers the cost of the products as well as their cost of application. Because this project also evaluated the effect of cane burning on weed control, we could also gauge the necessity of replacing the cane burning herbicide application with a different residual product, potentially off-setting some of those savings. Consequently, it was anticipated that this project would better identify the value of the cane burning practice for red raspberry producers and result in more profitable raspberry growing enterprises.

PROJECT APPROACH

A Master of Science student, Yushan Duan, began on assistantship on the project in January, 2010. She attended classes at WSU in Pullman during spring and fall semester, 2010, and was at the WSU Mount Vernon Northwestern Washington Research and Extension Center (NWREC) in the summers of 2010 and 2011. She completed her MS in fall, 2011, but continued on the project through 2012 and, with the exception of final pruning and training, has completed the field work for Field experiments #1 and #3 during the third and final year of the project.

Field Trial #1. This trial was designed for large-plot primocane management comparisons. Two red raspberry cultivars were tested in 2010 ('Meeker' and 'Coho'), both fields owned and managed by

Sakuma Brothers Farms near Burlington, WA. Plots measured at least 300 feet long (one row per plot). A third site with similar plot sizes was added for 2011 and 2012, a 'Cascade Bounty' field near Lynden, WA (Truman Sterk, Cooperator). 'Meeker' plots were tested from 2010-2012; 'Coho' plots were inadvertently oversprayed by the cooperator in 2011, so that trial was dropped in 2011. Treatments in 'Meeker' and 'Coho' were Aim alone, Goal alone, Sinbar alone, Aim + Sinbar, Goal + Sinbar, and a nontreated check, replicated three times. In 'Cascade Bounty', treatments were Aim, Goal, and Sinbar each used alone, and a nontreated check, replicated three times. Herbicides were applied in April of each year when primocanes were about 6 inches tall. Primocane re-growth (diameter and height) and weed control were measured biweekly through each summer. Berries were machine-harvested approximately every three days by the cooperator during July and August of each year, and berry weight from each harvest was recorded.

Berry yield. In all Field Trial #1 treatments, only applications to 'Meeker' resulted in significantly increased yield (Table 1). No treatments improved 'Meeker' total berry yield in 2010, while all treatments except Sinbar alone increased yield in 2011 and 2012 compared to nontreated 'Meeker'. Berry yield in the three year average followed the same pattern, except even Sinbar alone improved yield compared the nontreated raspberry, although Sinbar alone resulted in similar berry yield as did Aim applied alone. Given that treatment with Aim + Sinbar and Goal + Sinbar yielded more berries than did Sinbar alone, the lower yield from Sinbar alone was probably due to poorer weed control (discussed below) or reduced primocane growth during fruiting rather than herbicide injury.

Neither 'Coho' in 2010 nor 'Cascade Bounty' in either 2011 or 2012 produced significantly more berries than did nontreated raspberries, nor did they produce more fruit than raspberries treated with Sinbar alone (Table 1). The trend in the data, however, was toward that same conclusion in both cultivars; that is, cane burning resulted in nonsignificant numerical increases in berry production.

Primocane growth rate. 'Meeker' primocane growth rate was reduced by all treatments until 68 days after treatment (DAT) in 2012 (Figure 1). Growth rate of primocanes treated with Sinbar alone was greater than when applied in sequence cane burning herbicides, or by cane burning herbicides alone. By 87 DAT, primocanes in all herbicide treated plots were growing as quickly as nontreated primocanes. 'Meeker' primocanes in 2012 responded to cane burning herbicides in a similar manner as in previous years (growth reduction until 78 DAT in 2010 and 80 DAT in 2011, data not shown). Differential growth from Aim or Goal in 2012 was not as pronounced as in previous years, however. 'Cascade Bounty' primocane growth rate was reduced by Goal for the entire season, although the difference was slight by about 77 DAT (Figure 2). Aim also reduced primocane growth rate from 54 DAT through the rest of the season. Primocanes treated with Sinbar grew similarly to nontreated primocanes until the last measurement at 109 DAT, at which time growth rate slowed slightly. In 2011, 'Cascade Bounty' primocane growth rate was reduced by Goal until 80 DAT, and by Aim and Sinbar until 48 DAT (data not shown).

Weed control. In 'Meeker' (2010-12) and 'Coho' (2010), Sinbar applied with or without caneburning herbicides gave the best August weed control, exceeding 84% (Table 2). There were subtle differences between Aim and Goal in 'Meeker' over time. Weed control with Goal initially was superior to Aim (2010), but by 2012, weed control with Goal alone was only 16% compared to 46% with Aim alone. This result was primarily due to poor control of common chickweed (*Stellaria media*) by Goal over the three years, although the combination treatment of Goal + Sinbar was poorer than Aim + Sinbar by 2012 (84 and 96%, respectively). In 'Cascade Bounty', initial weed populations were very low, resulting in no significant treatment effect in 2012 (85 to 93% among treatments). It appears, then, that under conditions of low weed pressure, that cane burning herbicides can provide adequate weed control even when used alone. Under higher weed pressure, however, residual herbicides are necessary to maintain acceptable weed control, and that combination/sequential applications of cane burning herbicides with a residual

product may be superior to residual products alone.

Table 1. Total berry yield (kg/ha) in the first trial (2010-2012).

Treatment	Application Rate	2010	2011	2012	Average
		kg/ha	kg/ha	kg/ha	kg/ha
Meeker					
Aim	0.09 kg ai/ha	7716	8579 a	7,057 ab	7784 ab
Goal	0.47 kg ai/ha	9373	9450 a	7,052 ab	8625 a
Sinbar	1.34 kg ai/ha	8007	7940 ab	6,205 bc	7384 b
Aim + Sinbar	0.09 kg ai/ha+ 1.34 kg ai/ha	9310	9135 a	8,132 a	8859 a
Goal + Sinbar	0.47 kg ai/ha+ 1.34 kg ai/ha	8744	9166 a	7,892 a	8601 a
Non-treated	-	6758	6250 b	5,121 c	6043 c
Coho					
Aim	0.09 kg ai/ha	4,099	---	---	4,099
Goal	0.47 kg ai/ha	4,921	---	---	4,921
Sinbar	1.34 kg ai/ha	4,638	---	---	4,638
Aim + Sinbar	0.09 kg ai/ha+ 1.34 kg ai/ha	4,449	---	---	4,449
Goal + Sinbar	0.47 kg ai/ha+ 1.34 kg ai/ha	4,887	---	---	4,887
Non-treated	-	3,646	---	---	3,646
Cascade					
Bounty					
Aim	0.09 kg ai/ha	---	10,163	8,261	9,212
Goal	0.47 kg ai/ha	---	11,135	8,396	9,766
Sinbar	1.34 kg ai/ha	---	10,755	7,618	9,187
Non-treated	-	---	9,794	7,154	8,474

Means in each column followed by the same letter, or not followed by a letter, are not significantly different based on Tukey's Honestly Significant Difference method ($P < 0.05$).

Table 2. Weed control (%) in August in Meeker and Cascade Bounty (2010-12).

Cultivar	Treatment	Weed control		
		2010	2011	2012
Meeker	Aim	60 c	55 b	46 c
	Goal	70 b	47 b	16 d
	Sinbar	92 a	91 a	82 b
	Aim + Sinbar	89 a	96 a	96 a
	Goal + Sinbar	95 a	96 a	84 b
Coho	Aim	51 b	---	---
	Goal	52 b	---	---
	Sinbar	95 a	---	---
	Aim + Sinbar	95 a	---	---
	Goal + Sinbar	97 a	---	---
Cascade Bounty	Aim	---	96 b	93
	Goal	---	98 ab	85
	Sinbar	---	100 a	91

Means in each column followed by the same letter, or not followed by a letter, are not significantly different based on Tukey's Honestly Significant Difference method ($P < 0.05$).

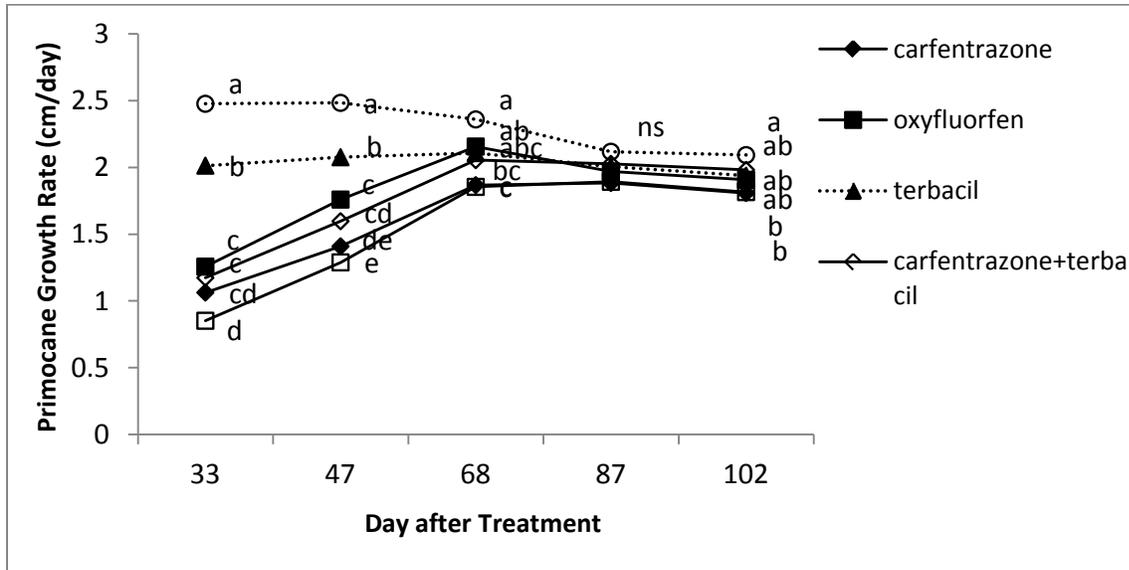


Figure 1. Meeker primocane growth rate (cm/day) in the off-station trial (2012). Products tested were Aim (carfentrazone), Goal (oxyfluorfen) and Sinbar (terbacil). Means at each date followed by the same letter are not significantly different based on Tukey's Honestly Significant Difference method ($P < 0.05$).

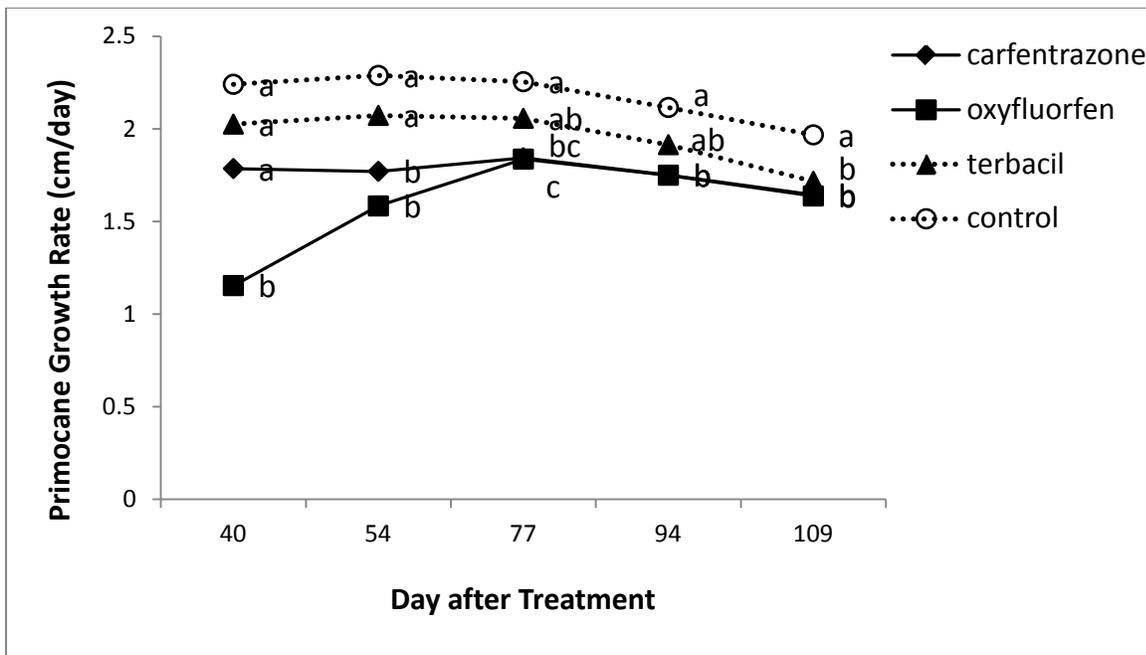


Figure 2. Cascade Bounty primocane growth rate (cm/day) in the off-station trial (2012). Products tested were Aim (carfentrazone), Goal (oxyfluorfen), and Sinbar

(terbacil). Means at each date followed by the same letter are not significantly different based on Tukey's Honestly Significant Difference method ($P < 0.05$).

Field Trial #2. This trial was designed for small-plot primocane management comparisons between 'Meeker' and 'Cascade Bounty' raspberries established in 2006 at WSU NWREC. Plots measured 30 feet long (one row per plot), replicated five times. Treatments were Aim, Goal, or a nontreated check and the same plots were used in all years. Cane burning herbicides were applied in April of each year, when primocanes were about 6 inches tall. Primocane re-growth (diameter and height) was measured biweekly through each summer. Berries were machine-harvested during July and August of each year, and berry weight from each harvest was recorded. Following harvest, two floricanes were randomly selected per plot for vegetative and reproductive measurements (height, diameter, lateral length, fruiting site counts). Also, the time it took to prune and train these cultivars was recorded during the first two winters of the trial to determine cane burning affects to this aspect of raspberry production; pruning and training time will be recorded later in 2012 for the third and final year of this project. Primocane growth data from 2010 and 2011 were provided in earlier reports, so we will present only 2012 measurements in this report.

Berry yield. Yield was significantly affected by cane burning treatment and between cultivars in two of three years; the interaction between these effects was not significant in any year nor in the 3-year average. Treatment with Goal increased raspberry yield in 2010 and 2011, but not in 2012 nor in the 3-year average (Table 3); treatment with Aim increased berry yield only in 2011. Although not statistically significant, the trend in the data was for higher yield from cane burning in all three years, however. 'Meeker' produced more berries than 'Cascade Bounty' in 2010 and 2011, and the 3-year average production of 'Meeker' was 28% greater than 'Cascade Bounty'. Even in 2012, when fruit yield did not differ by cultivar, the trend was for more fruit from 'Meeker'. As in Field Trial #1, the lack of interaction between cane burning herbicide and cultivar indicates that although neither cultivar responded individually to cane burning, cane burning increased berry yield when the two cultivars were averaged together.

Primocane growth rate. Cane burning herbicides slowed primocane growth in 'Meeker' until 67 DAT (Figure 3). Suppression by Goal continued until 82 DAT, after which treated primocanes grew similarly to nontreated primocanes. 'Cascade Bounty' primocane growth was suppressed essentially season-long by cane burning, although growth following treatment with Goal was similar to nontreated primocane growth by 115 DAT. In previous years, cane burning reduced primocane growth rate of 'Meeker' until about 68 DAT, while cane burning reduced primocane growth rate of 'Cascade Bounty' until about 98 DAT. 'Meeker' primocane growth rate did not greatly differ whether treated by Aim and Goal in any year, but Goal suppressed 'Cascade Bounty' primocane growth about 14 days longer than Aim in 2010 and 2011.

Nontreated 'Cascade Bounty' primocanes initially grew faster than 'Meeker' primocanes in 2012, although growth was similar between the two cultivars from 52 to 97 DAT (Figure 3). By 115 DAT, nontreated 'Meeker' primocane growth was greater than for 'Cascade Bounty'. This pattern was similar to primocane growth observed in previous years, so it appears that 'Cascade Bounty' primocanes grow more quickly early in the season then gradually slow, while 'Meeker' primocanes grow more quickly from mid-season on. This may help to explain some of the differential weed control from the two sites in Field Trial #1, as early-season 'Cascade Bounty' primocane growth may result in quicker bed shading and therefore greater competition to weeds.

Dormant Season. In 2010-11, pruning and training 'Meeker' took 20% longer than 'Cascade Bounty', equivalent to about 36 additional hr/ha (Table 4). Total time spent on 'Meeker' was reduced by an average of 45 hr/ha (18%) by cane burning. Both Aim and Goal were equally effective for reducing training time of 'Meeker'. Training time for 'Cascade Bounty' was not improved by cane burning,

although there was a trend toward reduced training time after treatment with Goal. In 2011-12, pruning and training time was not reduced by cane burning for either cultivar. Similar to the previous year, ‘Meeker’ took 22% longer to prune/train than did ‘Cascade Bounty’.

In general, pruned primocane biomass was not significantly different between cultivars after cane burning in 2010-11, although ‘Meeker’ produced less biomass than ‘Cascade Bounty’ when not cane burned (Table 5). Furthermore, pruned primocane weight from plots treated with Goal was 49 and 58% less with both ‘Meeker’ and ‘Cascade Bounty’, respectively, than for nontreated plots. Pruned primocane weight of ‘Meeker’ following Aim treatment was similar to that of nontreated ‘Meeker’, but Aim reduced ‘Cascade Bounty’ primocane biomass by 43% compared to nontreated ‘Cascade Bounty’. Primocane weight was generally greater in 2011-12 than in the previous year, but response to cane burning herbicides was similar. Goal reduced pruned ‘Cascade Bounty’ and ‘Meeker’ primocane biomass by 44 and 33%, respectively, compared to nontreated raspberries, while Aim reduced pruned primocane biomass by 26 and 21%, respectively. Pruned primocane biomass of ‘Meeker’ was 39% less than ‘Cascade Bounty’ in 2010-11 and 29% less in 2011-12.

Table 3. Total berry yield (kg/ha) in the second trial (2010-2012).

Treatment	Rate	2010	2011	2012	Average
		kg/ha	kg/ha	kg/ha	kg/ha
Aim	0.09 kg ai/ha	7309 ab	5483 a	6792	6528
Goal	0.47 kg ai/ha	8015 a	6018 a	6729	6921
Nontreated	-	6155 b	4063 b	5815	5344

Cultivar	Rate	2010	2011	2012	Average
Cascade Bounty	---	6203 b	4692 b	6027	5640 b
Meeker	---	8116 a	5685 a	6864	6888 a

Means in each column followed by the same letter, or not followed by a letter, are not significantly different based on Tukey’s Honestly Significant Difference method (P< 0.05).

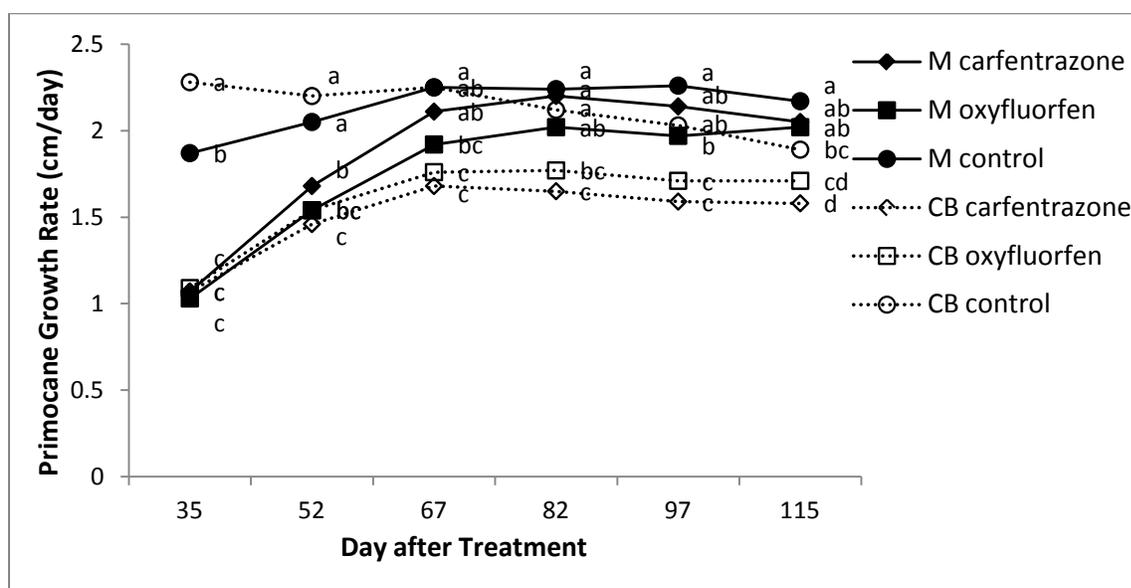


Figure 3. ‘Meeker’ and ‘Cascade Bounty’ primocane growth rate (cm/day) in on-station trials (2012). Products tested were Aim (carfentrazone), Goal

(oxyfluorfen). Means in each date followed by the same letter are not significantly different based on Tukey's Honestly Significant Difference method ($P < 0.05$).

Table 4. Total dormant-season training time (hr/person/ha).

Treatment	Cultivar		Treatment mean
	Meeker	Cascade Bounty	
2010-11			
Aim	204 b	186 a	196 B
Goal	207 b	168 a	186 B
Non-treated	250 a	189 a	218 A
Cultivar mean	218 A	182 B	
2011-12			
Aim	100	82	91
Goal	97	85	91
Non-treated	106	81	94
Cultivar mean	101 A	83 B	

Means in each column followed by the same letter, or not followed by a letter, are not significantly different based on Tukey's Honestly Significant Difference method ($P < 0.05$).

Table 5. Weight (kg/ha) of primocanes pruned off the bed.

Treatment	Cultivar		Treatment mean
	Meeker	Cascade Bounty	
2010-11			
Aim	1396 bc	1946 b	1671 B
Goal	925 c	1411 bc	1168 B
Non-treated	1829 b	3389 a	2609 A
Cultivar mean	1383 B	2249 A	
2011-12			
Aim	2491 a	3857 ab	3174 AB
Goal	2234 a	3201 b	2628 B
Non-treated	3351 a	4853 a	4103 A
Cultivar mean	2759 A	3910 B	

Means in each column followed by the same letter, or not followed by a letter, are not significantly

different based on Tukey's Honestly Significant Difference method ($P < 0.05$).

Field Trial #3: The red raspberry cultivars 'Meeker', 'Chemainus', 'Saanich', and 'Cascade Bounty' were transplanted into a new block at WSU NWREC in 2010. Cane burning was conducted on these raspberries using the nonregistered herbicides Vida (pyraflufen), Treevix (saflufenacil), and Rely (glufosinate) in April of 2011 and 2012. Berries were picked by hand three times in 2011 and by three machine harvests in 2012.

Berry yield. Total fruit yield differed by herbicide application in 2012 and also by cultivar, but there was no interaction between those two main effects. Berry yield was improved 25 to 30% by Treevix, compared to the other two cane burning herbicides or to nontreated raspberries (Table 6). Berry yield was higher in 'Saanich' than in either 'Cascade Bounty' or 'Meeker', while 'Chemainus' yielded similarly to both 'Cascade Bounty' and 'Meeker'. Lack of interaction between herbicide and cultivar indicates that cane burning was not a consistent factor in yield among these cultivars, at least in two- or three-year old raspberries.

Table 6. Total fruit yield after application of cane burning herbicides (2011-12).

Treatment	Rate	2011	2012
	product/a	lb/acre	lb/acre
By herbicide			
Vida	5.5 fl.oz	1486	1047 b
Treevix	1 oz	1714	1500 a
Rely	77 fl.oz	1667	1027 b
Non-treated	---	1454	1146 b
By cultivar			
Cascade	---	2947 a	1061 b
Bounty			
Chemainus	---	768 c	1232 ab
Meeker	---	328 d	924 b
Saanich	---	2278 b	1503 a

Means in each column followed by the same letter, or not followed by a letter, are not significantly different based on Tukey's Honestly Significant Difference method ($P < 0.05$).

Grower cooperators were excellent to work and invaluable for completion of this project. Obtaining yield data on grower fields and using their harvest equipment added credibility and insured that other growers could easily believe the results and likely see a similar response on their own fields. Both cooperators were excited about the research, and very interested in seeing the results on their own farm.

GOALS AND OUTCOMES ACHIEVED

Completed activities included off-station tests with 'Meeker' (three years), 'Cascade Bounty' (two years), and 'Coho' (one year) and two on-station tests: one with 'Meeker' and 'Cascade Bounty' (three years) and a second with 'Meeker', 'Cascade Bounty', 'Chemainus', and 'Saanich' (two years). A survey of Washington red raspberry producers provided baseline information about grower attitudes about cane burning prior to reporting on project findings. Portions of the project still remaining to be accomplished include the effects of cane burning on pruning and training (two years have been collected and the third year will be completed in November-December, 2012) and the final survey of grower attitudes (to be

conducted after training (Lynden, December 2012) and completion of fact sheet reporting on these result). Only short- and mid-term outcomes were expected from this project.

The project experimentation was very successful, with most of the anticipated work occurring. A few tasks were, however, not successfully accomplished. First, not as much field data was obtained as was hoped in Field Trial #1. Only three cultivars were tested, primarily because the new raspberry cultivars we were interested in including in our trial were either not available for long-term testing on grower fields, or not as large as we needed for a minimum level of testing (treatments of Aim, Goal, Sinbar, and nontreated was considered to be the minimum level). This shortcoming was alleviated through testing of four cultivars in Field Trial #3, including the cultivars in which the primary interest lay ('Meeker', 'Cascade Bounty', 'Saanich', and 'Chemainus'). Goal setting may have also been too ambitious in the desire to have measureable results by the end of the project. While this portion of the project will be successfully completed, it will not occur for several months. Despite these shortcomings, good data were generated that indicate that cane burning may not always be necessary in PNW raspberries. Conclusions from this research are as follows:

Berry Yield. Cane burning increased berry yield of 'Meeker' in two years of three, averaging 29 to 47% greater yield in treated plots over three years. At least some of this increase resulted from weed control, as residual herbicide alone increased yield by 22%. Conversely, 'Cascade Bounty', 'Coho', 'Saanich', and 'Chemainus' berry yield was not significantly increased by cane burning. There was a trend in the data suggesting that yield was marginally better in treated plots, but the numerical increase was within the margin of error for each trial. Although yield of individual cultivars was not greater with cane burning, when 'Meeker' and 'Cascade Bounty' yields were averaged together, raspberry yield was increased by treatment with either Goal or Aim during two of three years. Treevix also increased berry yield when yields of two- or three-year-old 'Meeker', 'Cascade Bounty', 'Saanich', and 'Chemainus' was averaged together.

Primocane Growth. Primocane growth rate was slowed by use of cane burning products for about 70 to 80 days. Goal slowed growth rate slightly longer than did Aim in both 'Meeker' and 'Cascade Bounty'. Biomass of pruned primocanes that had to be removed during the dormant-season did not differ between Goal and Aim treatments, although pruned primocane biomass tended to be marginally greater with Aim than with Goal.

Product Choice. There did not appear to be much difference between Aim and Goal in the cultivars used in this trial when applied at the tested rates. Goal slowed primocane growth longer than did Aim, but yield was not statistically increased. These products were generally inadequate for weed control unless a residual product was also used. This was particularly true in fields where weed pressure was higher, in particular when common chickweed was present, where Goal performed more poorly than Aim. Of single applications of the three nonregistered products, Treevix was more effective than Vida or Rely, significantly increasing berry yield of three-year-old raspberries.

Cultivar Choice. In side-by-side comparisons, 'Meeker' produced 18% more fruit than did 'Cascade Bounty'. 'Cascade Bounty' also produced about 30% to 40% more primocane biomass that had to be removed during dormant-season pruning. Despite this, 'Meeker' required significantly more time to prune and train than 'Cascade Bounty', about 20% longer in both years. In their first two harvests, 'Saanich' and 'Cascade Bounty' produced more fruit than 'Chemainus' or 'Meeker'. This is an indication of the relative precociousness of these cultivars, although it may also be partly due to more winter injury suffered by 'Meeker' than other cultivars.

Some of the more pertinent results from the baseline survey include:

(1) 80% of survey responders (24 growers) grow 'Meeker' raspberry, and 92% of those growers practice cane burning on that cultivar. 'Chemainus', 'Saanich', and 'Cascade Bounty' account for a combined 27% of growers (8 growers), and 100% of those varieties are cane burned each year.

(2) At least 70% of growers cane burn to increase yield, to provide weed control, or to improve harvest efficiency.

(3) 89% of growers use Aim to cane burn, followed by 59% who use Gramoxone (paraquat), 30% who use Goal, and 19% who use a combination of herbicides.

(4) 67% of these growers would consider modifying their primocane management programs based on data from this project, while 30% said "maybe" and 4% said they wouldn't consider changing.

The goal was to increase the knowledge of red raspberry producers about the benefits and risks of cane burning as a primocane management strategy. The target was that by 2013, one third of surveyed red raspberry growers would test a primocane management program that does not include cane burning. As the field portion of this research was conducted, preliminary results were reported at grower meetings (such as the Western Washington Small Fruit Workshop in Lynden, WA and WSU Extension/Whatcom Farmers/Skagit Farmers/Wilbur-Ellis grower meetings) and growers were informed of year-to-year progress toward confirmation of the research hypothesis. At the end of these grower meetings (the last is scheduled for early December, 2012) and following production of the final cane burning fact sheet (March, 2013), growers will be asked about their beliefs and thoughts about cane burning and, if they currently practice cane burning, whether they may consider changing their program in response to this new information. This will provide data as to whether the target outcome was achieved.

Pruning and training time for Trial #2 has been collected, and pruning and training for Trial #3 is about half complete. Once these times are fully available, they will be analyzed as in previous years, with an eye toward multi-year trends.

In Year 1 of Trial #2, we saw a significant reduction in pruning and training time due to cane burning for 'Meeker', but no significant effect in Year 2; pruning and training time for 'Cascade Bounty' did not change due to cane burning in either year. This will be the first full set of data for the four cultivars and different herbicides included in Trial #3.

Our plan is then to write up an extension-style fact sheet and mail these results to raspberry producers along with the follow-up survey, to be mailed by mid-February. In addition, we will publish a newsletter article including the final project data in the WSU Whatcom County Extension February newsletter. Based on survey responses, we will know if our measurable outcome (that by 2013, one third of surveyed red raspberry growers will test a primocane management program that does not include cane burning) was successfully achieved.

BENEFICIARIES

Raspberry producers in the PNW will clearly benefit from the results of this research project. Showing that the raspberry cultivars 'Cascade Bounty', 'Chemainus', 'Coho', and 'Saanich' did not produce significantly more berries in response to cane burning will give producers of those cultivars additional data to consider when deciding whether to cane burn or not in future years. It will also bring home in a tangible way the benefit of cane burning to reduce pruning and training costs in 'Meeker' during the dormant season (one year of two) as contrasted with 'Cascade Bounty', where cane burning did not significantly affect pruning and training time in either of the first two years.

Based on these data, it appears that 'Meeker' raspberry generally responds favorably to cane burning, showing an increase in three-year average berry yield and reduced dormant-season training and pruning time. 'Cascade Bounty' benefits less from cane burning than does 'Meeker', with cane burned plants

producing a similar berry yield and requiring a similar amount of time for pruning and training as did nontreated plants. Since 'Meeker' is by far the most widely planted raspberry cultivar in Washington, we do not generally recommend dropping the practice for most producers. Producers of other cultivars, in particular 'Cascade Bounty', 'Chemainus', and 'Saanich', should experiment with not cane burning every year to determine whether cane burning is a net benefit to their raspberry production systems.

LESSONS LEARNED

All project staff learned which raspberry measurements were of greater importance than others. For example, the number of primocanes measured for growth parameters in year one was substantially reduced in subsequent years, given that variability between canes and cane loss due to harvest damage were both lower than anticipated. This will be useful for project staff when designing future raspberry trials.

This was a project with a graduate student, so she was unquestionably the staff member who learned the most from this project. She learned how to apply treatments, manage field portions of the project, prune and train PNW red raspberries, and methodically collect data, as well gaining insight into the physiology of raspberry as it responds to cane burning treatments. She has presented findings in scholarly meetings as well during as her final defense seminar with WSU. She currently is enrolled in a PhD program, based in large part on her successful completion of the tasks in this project.

Although not completely unexpected, it is believed that the two grower cooperators learned much about how to establish and conduct statistically sound research. It is often surprising to first-time cooperators how replication of treatments is required for investigators to generate meaningful data. Perhaps the largest benefit they gain, apart from the results generated on their land, is this ability to test other management practices on their own fields after the experiment is done.

The incomplete level of outcome achievements in this trial has more to do with time than to results not matching expectations. The team expects that it can meet the goal of one third of raspberry growers re-evaluating their cane burning practices in light of these data, but the outcome will not be realized until the extension portion of this project is completed. In retrospect, this project was too ambitious in scope in that data analysis and reporting on the findings really couldn't be done in the prescribed timeline. Therefore, future projects need to allow more time for this aspect of project completion.

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ADDITIONAL INFORMATION

In-kind donations by the grower-cooperators were documented in 2010 and 2011 as targeted (\$10,000/ac/year of the trial was targeted; actual in-kind costs were 10,260/ac for 2011 and 2012). In-kind donations are at a similar level in 2012 (data will not be available until after pruning and training is completed during winter 2012-13). The expected donation will therefore total about \$31,000. These in-kind donations included crop husbandry at the Field Trial #1 sites (pruning and training, fertility, irrigation, pest management (except herbicides), and particularly, the cost of harvesting the berries).

Scholarly publications:

1. Duan, Y. and T.W. Miller. 2011. Determining the effects of cane burning to red raspberry in the Pacific Northwest. Weed Science Society of America, Portland, OR, WSSA Abstracts, CD.
2. Duan, Y., T. Miller, and T. Walters. To burn or not to burn, that's the question. VI International Weed Science Congress, Hangzhou, China (*in press*).

Presentations:

1. An update on cane burning in red raspberry. December 7, 2010. WSU Western Washington Small Fruit Workshop, Lynden, WA.
2. Weed research update. January 13, 2011. North Willamette Horticulture Society, Canby, OR.
3. Weed management in raspberries. December 9, 2011. WSU Washington Small Fruit Conference, Lynden, WA.
4. Weed research update. January 12, 2012. North Willamette Horticulture Society, Canby, OR
5. Raspberry spawn control: what we know and what we need to find out. July 19, 2012. Fruit for the Future, Invergowrie, Scotland, UK.

Washington State University
Sustainable Disease Control to Reduce Cost and Risk in Potato Production

PROJECT SUMMARY

Potatoes are the second most valuable crop in Washington, generating about \$3.4 billion annually. The warm climate and long growing season of the Columbia Basin favor higher potato yields and quality than nearly any other region in the world. However, these same factors favor Verticillium wilt (caused by *Verticillium dahliae*). To control this disease farmers are highly dependent on soil fumigation with metam sodium. Each year 90% of potato acres in Washington are fumigated, costing an estimated \$25 million. Washington potato growers need alternatives to fumigation to control Verticillium wilt.

In addition to being costly, farmers are now seeking to reduce dependence on fumigation because of increasing regulation, market demands, and their own interest in improving soil quality. The 2008 U.S. EPA re-registration decision for metam sodium will increase farmers' application costs and will eliminate some uses, particularly near populated areas. In March 2009, the McDonalds Corporation, the largest buyer of potatoes in the U.S., agreed to promote pesticide use reduction within its American potato supply chain. This will increase pressure on farmers to adopt alternatives to fumigants. Regions that best respond to these market forces will be more competitive. Finally, surveys of Washington farmers indicate that many would like to improve their soils, but it must make economic sense. A practice that could replace fumigants and improve soils would be eagerly adopted by Washington potato farmers.

If green manures could be used in place of metam sodium, Washington's ~250 potato producers could save \$10+ million each year (about \$109 savings per acre using 2008 costs). This does not include the value of the increased soil quality, carbon sequestration, reduced erosion, or other cropping system benefits of the green manures on the 165,000 acres of land producing potatoes each year. These benefits would enhance the competitiveness of Washington potato production and potentially benefit production of other vegetable crops such as onions, carrots and green peas, all of which are currently grown after green manures in Washington on small acreages

PROJECT APPROACH

Field plots of selected green manure treatments were planted at both the WSU Othello (silt loam) and OSU Hermiston (sandy loam) research centers. Field treatments were designed to test the ability of various green manure crops to suppress *V. dahliae*. The project team tested three types of green manures (high-glucosinolate Brassica (*B. juncea*), low-glucosinolate Brassica (*B. juncea*), and non-Brassicaceae barley (*Hordeum vulgare*), both as short-cycle green manure crops following a spring wheat crop and as a full-season treatments (three successive green manure crops). The following treatments were replicated 4 times in a completely randomized design in 1.5 x 4.5 m plots at both sites:

1. Spring wheat – fumigation (+ control)
2. Spring wheat – no fumigation (- control)
3. Spring wheat – barley GM
4. Spring wheat – high-GL Brassica (*B. juncea*) GM
5. Spring wheat – low-GL Brassica (*B. napus*) GM
6. Barley GM x 3 GM
7. High-GL Brassica (*B. juncea*) x 3 GM
8. Low-GL Brassica (*B. napus*) x 3 GM

GL=glucosinolate, potential source of biofumigation; GM = green manure.

The treatments were applied to 32 plots for one year and on another 32 plots for two consecutive years at both sites (see note about Othello site below). Then, in the 3rd year, all 64 plots were planted to potatoes.

The factors being compared by these treatments are 1) green manure biomass; 2) inclusion of a Brassica green manure; 3) high and low glucosinolate levels in the green manures; 4) wheat in rotation, and 5) fumigation.

Soil levels of Verticillium, Black Dot, Fusarium and Pythium were monitored in all plots, both sites, through analysis of samples taken every spring and fall.

The potatoes were monitored and the stems rated for Verticillium incidence and severity four times during the season. At harvest, yield was measured for the following market classes: culls, <4oz, 4-8 oz., 8-12 oz., >12oz, and total yield. Tubers were collected for evaluation of Verticillium and Black dot. Soils were transported from all the treatments at the Hermiston site to microplots at Pullman. Potatoes were grown in the microplots and evaluated by measuring plant necrosis at six stages (and combining these into an area under the senescence progress curve, AUSPC), leaf chlorophyll levels, tuber black scurf incidence and severity, tuber yield and number, and aboveground biomass. The same was done with soils from Othello plots in 2012.

Although the team started field activities at both Othello and Hermiston in the spring 2010, the original plots at Othello were abandoned after the project team received the results of the soil analysis from spring soil samples. Although preliminary soil analysis from both sites in the fall of 2009 showed significant levels of Verticillium, the results from individual plot samples in the spring of 2010 showed lower Verticillium levels in Othello. The levels were so low that any treatment effect on Verticillium might not be evident, and so the decision to find a better site was made. However, since other fields had already been cropped, the start of the Othello trial had to be postponed until 2011. Therefore, activities at Othello plots will not be completed until 2013. The soils data from the Othello trial will be analyzed in relation to the 2013 potato results. Funding from sources other than SCBGP was necessary to finish the work at both sites, so this delay at Othello did not create any problems with the SCBGP end date. The project at Othello will be finished using other funding.

Team members completed a thorough literature review of the topic of using green manures in potato production.

Significant results:

Treatment application

Green manure biomass, means for each treatment, tons(dry)/acre:

Barley

1x=2.2, 2x=4.9, 3x=7.9, 6x=26.6

High glucosinolate mustard

1x=4.1, 2x=11.6, 3x=6.1, 6x=23.2

Low glucosinolate mustard

1x=4.0, 2x=8.5, 3x=6.3, 6x=25.2

Soil fungal assays

- There was no significant correlation between the spring 2012 soil fungal levels and any of the yield measurements.
- Although there were significant treatment differences for the changes in soil fungal levels over the three years of the project, the patterns were not consistent from one year to the next and so no conclusions can be made.
- The Pythium, Verticillium and especially the Fusarium levels were higher in the two year treatments (2010-2011) than in the one year treatment plots (2011). This could be the cause of the significantly different yields in the two sets of treatments, and for this reason the project team decided to analyze the two sets separately. Other possible

causes for this are the corn crop preceding the one year treatment (rotation effect) or nematodes, which were not monitored.

- There was no evidence that soil fungal levels were significantly affected by green manure incorporation in the long-term (> 1 year). There were no differences between treatments in the Verticillium levels measured just before potato planting. This confirms other research showing that green manures do not reduce Verticillium inoculum in the soil.
- While there was some evidence that Pythium levels increased after green manure incorporation, this was not always observed and when it was, the levels always decreased by the next measurement. The results from Othello will be important in confirming or rejecting these observations from Hermiston.

From the 2011 Microplots:

- The percent plant necrosis (potato) was significantly different among treatments with the 3x green manure treatments doing the best. The same was true for the AUSPC measurements.
- Aboveground potato plant biomass results showed that the high glucosinolate x3 mustard treatment was significantly lower than the other two x3 green manure treatments. Three of the green manure treatments had significantly higher potato biomass production than the wheat-fumigation treatment.
- Tuber yield were highest in the low-glucosinolate mustard x3, the barley x3 treatments, and the wheat-fumigation treatments. Wheat-no fumigation produced the lowest yields.
- These results, while somewhat variable, support the hypothesis that there is benefit to green manures, and that increasing green manure biomass results in more benefits.

From the 2012 Microplots

- Treatments with the low glucosinolate mustard had higher disease severity than other green manure treatments, yet produced higher yields. This contradicts some of the results from the 2011 microplots.
- Unlike the 2011 results, there was no treatment differences measured for AUSPC.
- Overall, there were very few differences between the treatments in the measurements taken, and the differences that were measured were not sufficiently large or consistent enough to allow us to make conclusions.

From the 2012 field plots at Hermiston

Two-year treatment plots – disease incidence and severity

- There were no significant treatment differences in any of these measurements. For some unknown reason, disease incidence was much higher in this set of treatments than in the one-year treatments.

Two-year treatment plots – yield

- There were no significant treatment differences (ANOVA) in any of the potato yield factors measured (culls, <4oz, 4-8 oz., 8-12 oz., >12oz, and total yield) in the plots receiving two years of treatments. There was high variability of yields and other measurements within these treatments.
- There were no yield differences between the fumigated and non-fumigated control in these plots.

One-year treatment plots - disease

- The wheat-barley and Low glucosinolate mustard x3 treatments had higher Verticillium incidence in the stem ratings and higher AUSPC than the other treatments.

One-year treatment plots – yield

- The higher disease ratings translated to lower 8-12 oz., >12 oz., and total tuber yields compared to the fumigated control and the Barley x3 treatments.
- There were some differences in yields between treatments for the 8-12 oz. and total yields, but they were minor and were not conclusive.
- The fumigated control had higher total yields than the green manure treatments which were greater than yields from the unfumigated treatment.
- There were no differences between the high and low glucosinolate treatments.
- There were minor differences in yield classes between Brassica and non-Brassica treatments, but no difference in total yields.
- Fumigation resulted in higher 4-8 oz. and total yields when compared to all unfumigated treatments.

There was no correlation between green manure biomass in the treatments and yield components.

The team believes that, while the Hermiston results can stand alone, the results from the Othello site will be important in confirming or rejecting them, or confirming different results from applying the treatments to different soils types.

The project team included faculty from both Washington State University and Oregon State University:

Institution and personnel	Role
Andrew McGuire, WSU Extension	Project director, Extension and Research
Lynne Carpenter-Boggs, WSU	Research (soil microbiology) and Extension
Dennis Johnson, WSU	Research (Verticillium)
Philip Hamm, OSU	Research (Verticillium) and Extension
Don Horneck, OSU	Research and Extension

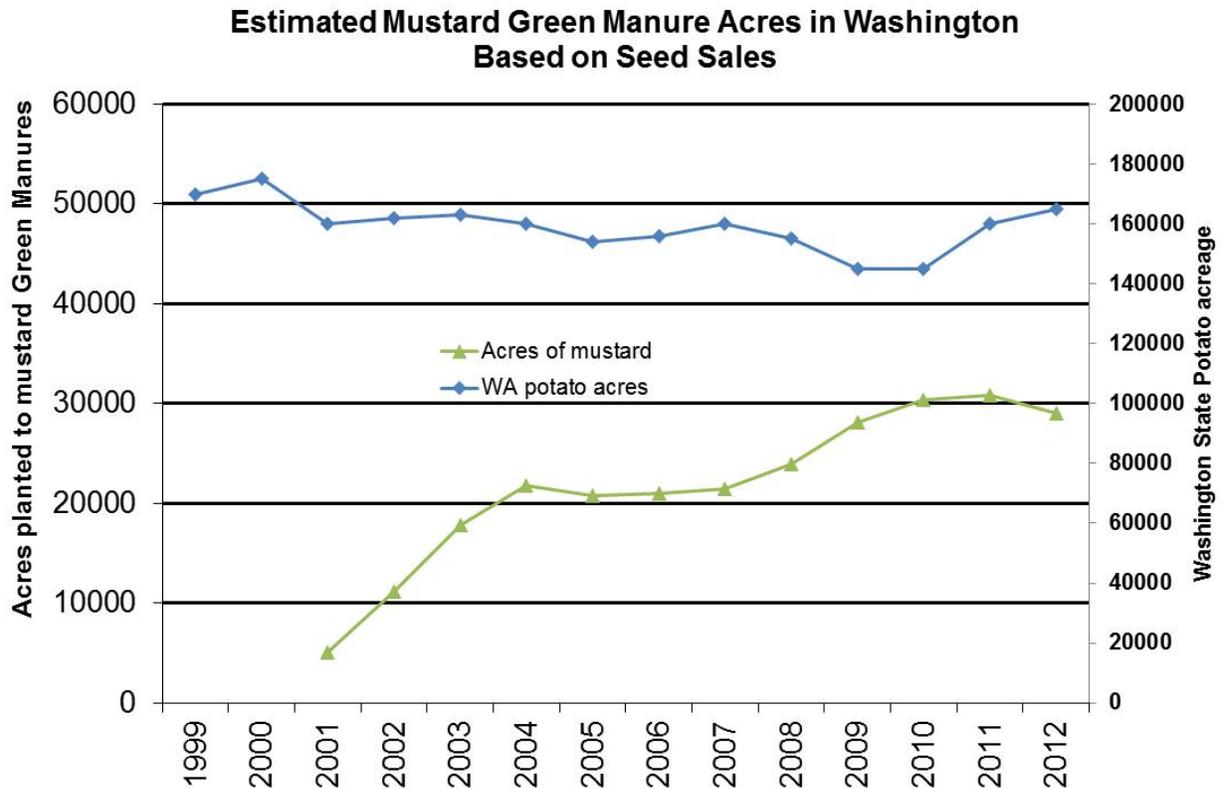
GOALS AND OUTCOMES ACHIEVED

- As part of ongoing evaluation, an annual survey was conducted to determine mustard seed sales in the Columbia Basin.
- The project team completed a 2010 survey of potato growers. This survey contacted potato growers in the Columbia Basin region of Washington State to find out about their use of metam-based (metam sodium and metam potassium) fumigation and green manures. A four-contact mailing sequence was used to obtain responses. Respondents also had the option of completing the survey online if that was a preference. Of the 235 respondents contacted, 70 respondents completed the questionnaire. This return yielded a response rate of 33.3%. This provided baseline data and will be repeated in 2015.

- The long-term outcomes will be measured in 2015, but initial results (see 2010 survey results in #9 below) indicate that some growers are using green manures to replace metam sodium, and that more will adopt the practice with better scientific data. This shows the potential of this project but also that results will be seen in the long- rather than short-term.

Planned activities	Completed
Obtain seed and supplies	X
Advertise and hire post-doc.	X
Prep field sites in Othello and Hermiston.	X
Take soil samples	X
Seed first set of crops.	X
1st soil analyses.	X
1 st GM crop chopped and incorporated	X
2 nd GM crop seeded	X
2 nd GM crop chopped and incorporated, wheat harvested	X
3 rd GM crop seeded	X
Plots fumigated, 3 rd GM crop chopped and incorporated	X
Fall soil sampling	X
Fall soil analyses	X
Obtain and transport soil to Pullman from each 1 st year plot	X
Repeat above steps for second year of GM crops.	X
Establish pot study	X
Pot study final assays	X
Begin mechanistic studies: biotic/abiotic, general/specific	
2 nd pot study establishment	X
Mechanistic studies phase 2: systemic resistance	
2 nd pot study final assays	X
Hold green manure field demonstrations	X
Hold green manure field days	To be done after Othello trial is finished
Revise and update green manure website	X
Produce revised and new publications	To be done after Othello trial is finished
Make presentations to potato producers	X
Meet with advisory committee	X
Present materials regionally and nationally	To be done after Othello trial is finished

The results of the yearly seed sales survey is shown below.



The project goal was to increase the acres planted to green manures to 55,000 by 2015. The 2012 estimate is about 29,000 acres, so the goal has not yet been achieved. The project team was aiming for a 15% annual increase but achieved only a 4% annual increase in the acres planted to mustard green manures.

The main results of the 2010 potato grower survey:

- Over half of the respondents had used green manures (mostly mustard or mustard blends) before potatoes, with larger farms more likely to try it than smaller farms.
- Almost half of those who had used the practice had tried it first within the past three years.
- The soil-building rather than pest control benefits were most important to farmers making the decision to try green manures.
- Better soil tilth, increased soil organic matter, reduced wind erosion, and improved water infiltration were the top rated benefits of using green manures before potatoes.
- Only 17% of respondents reported using green manures to replace metam-based fumigation, but of those, 64% reported results equal to those obtained with fumigation.
- Only 26% of respondents plan to use green manures to replace metam-based fumigation in the future. However, if additional scientific data were available showing that green manures could successfully replace metam-based fumigation, those who would consider trying this would increase to 71%.

This survey will be repeated in 2015 to measure changes.

BENEFICIARIES

Potato growers in the Columbia Basin of Washington and Oregon will benefit from this project, but because the project work took all three years to complete, and because work at one of the two project sites was delayed, this benefit has not yet been realized.

Because the research data was obtained at the very end of the 3 year project period, the results have not yet been disseminated to growers. However, the 12% increase in mustard green manure use during this project shows that farmers are benefitting now, even without this research data. Green manures are known to improve soil quality, and so even while this research was focused on the disease suppression, farmers are benefitting from the practice in other ways. Without the disease suppression and associated replacement of fumigation with green manures, however, it is difficult to estimate the economic benefit of this increase in use of green manures.

LESSONS LEARNED

The research results, so far, are inconclusive. Because of the high variability in the Hermiston plots, no conclusions can be made from the results there. High variability a risk inherent in agricultural field research, and although actions were taken to minimize this risk, they were not successful. However, half of the field trial portion of the project has not been completed. The field trial at Othello is moving forward with other funding and will be completed in late 2013. This trial may still yet provide the benefits planned for this project.

Although the challenge of completing this research was recognized from the beginning, and measures were taken to increase the chance of success, the complexity of the biological systems involved is daunting. The interaction of green manures, soil biology, and specifically soilborne diseases is still largely a “black box.” Researchers can measure what goes in and what comes out of the box, but still do not have an accurate view of what goes on inside the box. In addition, it is not clear that there is a readily available solution to this problem. Field research of this type is risky, but for now, it is the best option. Perhaps new soil DNA techniques (one of the project team members is pursuing this line of inquiry) will allow us to peer into the soil’s black box, but until other tools are developed, the project team will have to continue this type of field research.

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ADDITIONAL INFORMATION

Total WSU Cost Share: \$71,336.47. Other funding provided by the Washington State Potato Commission (2010: \$8,770; 2012: \$12,961) and Oregon Potato Commission (2012: \$6,209).

Mustard green manure website, updated during this project:
http://csanr.wsu.edu/pages/Mustard_Green_Manures

Literature Review: Green Manures and Biofumigation to suppress Verticillium wilt: review, by Ahmed Al-Hammouri (available upon request).

Washington State University
Homeowner Pest Education

PROJECT SUMMARY

Washington State is the leading state producer of apples, pears, and cherries with over 200,000 acres of these specialty crops. Annually, these crops contribute over \$2 billion dollars to the state's agricultural economy. While these tree fruits are of extremely high value, consumers in domestic and foreign markets do not tolerate fruit damaged by codling moth, *Cydia pomonella*, and the western cherry fruit fly, *Rhagoletis indifferens*. These fruit pests are often found in backyard trees and can serve as a reservoir of pests that spread to commercial orchards. Improperly managed backyard fruit trees are often the source of these pests that are capable of dispersing to and producing economic damage to commercial crops. These pests directly impact both the quality and marketability of commercial fruit.

Commercial growers are making the transition away from the broad-spectrum organophosphate insecticides to more environmentally friendly management strategies to control these pests within their orchards. As growers continue the transition and key organophosphate insecticides are removed from the market, they experience additional challenges in controlling key pests that originate outside the orchard.

This project was intended to educate backyard fruit growers about these pests and how they affect commercial orchards. It also planned to demonstrate viable low risk methods for homeowners to control codling moth and cherry fruit fly, and to evaluate the impact that proper management of backyard fruit trees has on the spread of these pests to adjacent commercial orchards.

This project was not based on previous SCBGP work, however, it is based on work conducted by Tim Smith of WSU Extension Wenatchee, and work conducted by Ken Bessin and John Hartman of University of Kentucky Extension and their previous work on apple bagging.

PROJECT APPROACH

This project involved outreach to both growers and backyard apple and cherry growers and educating them about the apple pest codling moth, and the cherry pest western cherry fruit fly.

Apple:

Codling moth monitoring was begun in April of each year with weekly trap checks and data recording at each trap site. Apple trees were pruned and thinned, followed by the actual bagging of the apples in early June, when the appropriate size was achieved by the apple fruit. All damaged fruit was thinned and recorded at the time of bagging. During the first two seasons, ten percent of the fruit was left exposed on each tree, to serve as a control for the project. In the third and final growing season, fifty percent of the fruit was left exposed on each tree to serve as a control. The control fruit was monitored each week, and any damaged fruit was removed and recorded during each of the three seasons. The bagged apples were monitored for growth and development, and it was learned that here in Central Washington, the fruit must achieve at least 25mm (quarter size). If the fruit is not allowed to reach this size, it will spontaneously drop. In other areas of the world such as Japan and the Eastern United States, fruit can be bagged at smaller size avoiding early codling moth injury. Here in Central Washington, apples must be bagged at a later and larger stage of development, while tolerating some injury by codling moth - the injured fruit is removed and discarded and codling moth larvae on the project trees are not allowed to complete their life cycle. The supplier of the apple bags has adopted the recommendation to wait until proper size is achieved by the apple fruit and then bag from the results of the project. From a quantitative view, the project was presented to both the Master Gardeners of Yakima County and Benton County, and they are proponents of the method in order to avoid: codling moth injury, hosting codling moth, creating problems for commercial growers. The method has been adopted by several Master Gardeners with apple

trees, and they are introducing their neighbors with apple trees to the method. In other cases, the backyard apple growers have made the decision that the method was too labor intensive and voluntarily allowed the apple trees to be removed. At two project sites the codling moth moving into the neighboring commercial orchard were reduced to zero by bagging the backyard apples. Correspondingly, the injury was reduced to zero codling moth injury as verified by pack out reports from the orchardist warehouse. Previously the growers were forced to perform a more stringent spray regimen, and still bear some losses to codling moth as was also shown by previous years pack out reports. These growers have been able to reduce their numbers of sprays and also reduce acreages sprayed, a positive outcome from both an economic and ecological viewpoint.

Cherry:

Western Cherry Fruit fly monitoring and control was performed for three seasons at multiple sites, comprising both commercial and backyard trees, and how well control could be performed utilizing GF 120 Naturalyte Insecticide, an organic approved product produced by Dow AgroSciences. In the case of cherries, weekly monitoring of the sites began in mid May utilizing baited yellow sticky traps. At the first detection of an adult fly, the applications were began of GF120. Monitoring and applications were continued until late August when no more adult cherry fruit fly were caught. In the event of rain, another application was made the following day, as GF120 is not rain-fast. At harvest time samples were taken from both backyard cherries and commercial cherries as well. The fruit was inspected for damage both visually and by the same method as is used for export cherries: 7 pounds of brown sugar is dissolved in 5 gallons of water, and crushed fruit is submerged in this sugar water. Any cherry fruit fly larvae present in the fruit floats to the surface and were collected and verified to be cherry fruit fly larvae and were counted. At the control sites, utilizing an infested backyard cherry tree where no applications were made and a non production unsprayed juvenile cherry orchard, detections were made in the commercial orchards fruit, as well as in the backyard fruit. At another location where no applications were made to infested backyard trees, the commercial orchard was sprayed with GF120 on a weekly basis by the orchardist and no detections were made in the commercial cherry fruit which was monitored with traps and the fruit inspected in the same manner with sugar water. Two replicates utilizing adjoining backyard cherry trees were also monitored and weekly applications of GF120 were made to one tree at each site. In this case control was not as good as was hoped, with 100% infestation in the unsprayed cherry trees as was expected, but there was over 10% infestation in one case in the sprayed tree. We are unsure as to the cause, but the trees are located only 75 feet apart, and it is surmised that reproduction and oviposition were more important than feeding on the GF120 which is a bait, not a contact insecticide.

Project Partners including the following:

Yakima:

Dr. Mike Bush of WSU Extension Yakima designed and managed the project, as well as performed oversight. Jeff Upton performed outreach and applications of GF120 as well as monitored the apple bagging and pest monitoring Henry Vander Houwen performed weekly monitoring of the traps and data collection as well as performing the cherry evaluations

Benton County:

Maryanne Ophardt of Benton County WSU Extension managed the Benton County personnel, and performed local management Frank Wolf performed outreach and applications of GF120 and monitoring of the projects involving apple bagging and cherry evaluations. Jo Boone performed trap monitoring in both the apple and cherry projects in Benton County. Pete Mellinger performed trap monitoring and consulting to both Yakima and Benton Counties from the standpoint of a commercial cherry orchardist (retired)

GOALS AND OUTCOMES ACHIEVED

The primary activities performed were the selection of proper sites for the apple and cherry aspects of the project, as this involved both commercial and backyard producers of fruit. This was critical to the project as there is great need for backyard fruit tree growers to understand that the pests that originate in their trees cause great harm to commercial producers. By educating backyard fruit producers, it has in a small scale at this time became apparent to them that if their apple and cherry trees are not maintained in a pest free manner, neighboring commercial growers have to spray more frequently and experience insect damaged fruit, which results in economic hardship to the commercial growers. In some of the cases, at the completion of the project, the backyard fruit trees have been removed as the homeowners now realize that the work involved is more than they are willing or able to devote to their fruit trees. In other cases, the backyard growers are now educated and willing to perform the work needed, and they are also assisting other backyard fruit growers with performing sprays and bagging of their apples.

As was noted above, backyard growers that have adopted apple bagging and GF120 sprays are now educating their neighbors and friends about these methods. Another long term goal was achieved by educating the WSU Master Gardeners about the methods and they now educate the public about the methods.

Project goals were to educate the public and reduce the pests originating in backyard apple and cherry trees in both Yakima and Benton County. In both of the Counties, commercial orchards are now impinged upon by neighborhoods and therefore backyard fruit trees. The commercial growers are in large part negatively impacted by these backyard apple and cherry trees. Through this project, a number of growers now are able to reduce the number and frequency of their insecticide applications and they now experience lower codling moth and cherry fruit fly damage.

It was initially hoped that GF120 would be made available in a smaller package that was more "homeowner friendly" after it was demonstrated that there was enough interest. Unfortunately this is not the case as the manufacturer has decided to not offer the material in smaller packaging. It was also hoped that 100% control of cherry fruit fly would be possible, but this was not the case, as in some instances there were detections made in backyard cherry fruit of larvae. There was however improvement as rather than 100% infestation with larvae it was greatly reduced to a high of 10% in one case.

In the case of apple bagging, all goals were met. Codling moth affecting the commercial growers was eliminated as bagging effectively stops the life cycle of this pest. Commercial growers with neighboring backyard trees were able to reduce insecticide sprays and experienced no codling moth damage.

One commercial apple grower experienced 12% codling moth cullage in his packed fruit due to 22 unmanaged apple trees prior to the project. After the first season, there was no codling moth damage detected at the warehouse where his fruit was stored and packed. In the case of cherries, a commercial grower had experienced very large trap catches of cherry fruit fly and was forced to make insecticide sprays on a frequent basis in order to avoid having infested fruit. After the project began the trap catches were greatly reduced to less than one-tenth of what they were prior to the project. The owner of the nearby unmanaged cherry tree has since agreed to removal of the tree, as he is unwilling to spray because it is "too much work." This is a positive outcome as "no host" means "no pest."

One of the Expected Measurable Outcomes was to reduce codling moth and western cherry fruit fly in targeted backyard trees by 98%. For backyard apple trees, the project reduced the incidence of damage to the fruit to levels below 2%, which is considered acceptable for commercial production standards and indicates that the target was met. The codling moth-damaged apples were due to apples being bagged that had codling moth eggs already laid on the surface of the fruit, and this is difficult to detect. This means that the bagged apples went from 100% infested prior to the project to 98% undamaged from codling

moth after the implementation of bagging. Initial damage prior to the actual bagging was quite high in some cases - as much as 15%. The damaged fruit was removed and destroyed prior to bagging. In the project apple trees, each tree was thinned of its fruit to at most 25% of its initial apples, so any codling moth infested fruit being destroyed resulted in further reduction of codling moth. In the case of these backyard trees, populations of codling moth rebound quickly, due to other unmanaged apple and pear trees in the vicinity. This was documented by monitoring trap counts performed in the backyard trees.

For backyard cherry trees, a reduction was achieved, from 100% infested backyard cherry fruit, to a high of 10% infestation in the same tree the following year. The other cherry sites were better, with only perhaps 2-4% infestation in the cherry fruit. Cherry fruit fly damaged fruit went from 100% infested fruit to 90% clean in the worst site to 98% clean fruit in the best sites. Therefore, the outcome was met in most cases. The neighboring commercial growers which previously had experienced elevated trap counts of cherry fruit fly saw a huge reduction in the number of adult flies caught. In commercial cherry production, any trap catch is considered a cause to spray, as cherry fruit fly is a "zero tolerance" pest." Although the results were promising, the hope of zero cherry fruit flies was not achieved.

The second Expected Measurable Outcome was that 50% of targeted backyard growers would adopt the demonstrated "Integrated Pest Management" techniques. This outcome was successful, with 5 out of 8, or 63%, of participants adopting IPM practices. The other three participants have chosen to remove their fruit trees, which is still a successful outcome for the nearby commercial growers.

BENEFICIARIES

Commercial growers and backyard growers have both benefitted from the project, with the benefits more heavily weighted towards commercial growers, as intended. The small number of project participants have now begun to educate others of the benefit of proper pest management, including how it reduces costs and is more ecologically sound.

Although the economic benefits for each grower was not measured, one commercial apple and one commercial cherry grower shared that they were able to reduce their sprays dramatically. The apple grower reduced his codling moth sprays from six per season to two per season. The cherry grower was able to reduce his sprays by one-third, down to a total of four. (In the case of cherries, there is zero tolerance of cherry fruit fly and therefore growers must spray in order to avoid any detections.)

Backyard growers that have adopted the program now experience no codling moth damage and greatly reduced cherry fruit fly injury. They also do not contribute pests to nearby commercial growers as was demonstrated in trap data that showed no codling moth in traps directly abutting the backyard trees. They also are no longer utilizing conventional insecticides that are disruptive to natural enemies and beneficial insects.

LESSONS LEARNED

Lessons learned included the following:

- It is necessary to limit the number of participants in the project as the work can become labor intensive, particularly at apple bagging time. Codling moth injury in the last-to-be-bagged fruit was rather high due to time constraints.
- All parties must be consistent in data collection methods so that the data is meaningful to the project.
- The correct timing of bagging apples in Central Washington is very important, and some varieties just don't work for bagging due to the heat destroying the bagged apples.

- In the case of cherries, it was hoped that GF120 would achieve 100% control of cherry fruit fly, and that was not observed, even with diligent applications. Great reductions were achieved, but not 100%.
- The working group met several times throughout each season, but it would have been better to have met more frequently to communicate better and problem solve together, rather than by phone.

On a positive note, this outreach project has made WSU Extension and the Benton and the Yakima County Pest Boards more visible to the local constituents that they serve. Citizens have become interested in the project and are willing to adopt the program.

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ADDITIONAL INFORMATION

In-kind funds were primarily derived from time devoted to the project. In Yakima County, 640 hours were devoted per season by Jeff Upton totaling 1920 hours over the three years of the project. This equals approximately \$42,000. Mike Bush devoted 800 hours of his appointment to the project equaling \$28,000. In Benton County, Frank Wolf devoted the same 640 hours over the four month season each year, totaling 1920 hours. This equals approximately \$40,000. Maryanne Ophardt dedicated 800 hours of her appointment to the project equaling \$25,000.

A “how to” apple bagging video was produced by Benton County, with Jo Boone performing this aspect of the project. Jo served as the videographer and Frank Wolf performed the actual bagging. The video was placed on DVD and is available to the public for free distribution. It is currently being reviewed by WSU for inclusion on the WSU "YouTube" channel.

"Growing Backyard Apples Without Pests" was produced and is available for free distribution through the Yakima Horticultural Pest & Disease Board. A copy will be included on the updated Yakima County Horticultural Pest & Disease Board webpage by January 1, 2013.

Cascade Harvest Coalition
Washington Specialty Crop Farmer-Buyer Trade Meetings

PROJECT SUMMARY

Washington State specialty crop farmers who want to connect with local buyers often do not have the time or skills necessary to develop successful business relationships. In addition, chefs, food service providers and institutional food buyers looking for locally sourced products lack networks to find producers and are faced with an ever increasing consumer demand.

This project worked to provide specialty crop producers with education and networking opportunities, inspiring creative sales strategies, building new relationships with food buyers and increasing the purchase of local products. Events also worked to educate chefs and buyers about what products were available, how to use them and how to work with (perceived and real) barriers of volume, pricing, processing, distribution and seasonality.

Over the course of three years the funding from the WSDA Specialty Crop Block Grant Program (SCBGP) allowed Cascade Harvest Coalition (CHC) to build off of a well-known Farm-to-Table Workshop Series, funding 14 regional workshops, including a Northwest WA event coordinated in partnership with Sustainable Connections (SC). The SCBGP also supported the Seattle Chefs Collaborative (SCC) in the expansion of popular Farmer-Chef Connection (F2C2) and Meet & Greet (MG) events. Coordinating farmer-buyer events between all grant partners in this one project created a “clearing house” for these events in the State, aiding in effective collaboration and an efficient use of resources.

National and local shifts have occurred towards promoting local food sources for economic, health and environmental reasons. Large and small buyers alike have made commitments to purchase more locally sourced products from small- and mid- scale farmers. For instance, in 2011, [Wal-Mart](#), the nation’s largest retailer, developed sustainability commitments which resulted in an increase of locally sourced produce by 97%, accounting for 10% of all the produce sold. Increases in local purchasing can also be seen in institutions. In 2010, 72 school districts worked with 47 farms throughout Washington State took part in [Taste Washington Day](#), incorporating local products in school cafeteria menus and generating approximately \$17,000 in sales on the actual day and an estimated \$90,000 in the following 6 months. Consumer demand can be demonstrated in a rise in the number of farmers markets from 1,755 in 1994 to 7,864 in 2012, with a 9.6% increase in the number of markets from 2011 to 2012 ([USDA AMS](#)). This project was and will continue to be extremely timely with such emphasis and energy being put into sourcing local products.

Just as the work of food producers is a 24-7 job, the work of supporting local producers and helping to form connections with buyers is never complete. Changes in the economy and environment annually create new challenges that must be addressed and food trends can shift at any time. Responding to these factors can be staggering for small-scale food producers who often are not only farmers, but also the processors, marketers, sales representatives and distributors of the food they produce. Buyers and producers were given an opportunity to network and to learn more about what each other need in order to make a good sales relationship.

PROJECT APPROACH

Total attendance at all Farm-to-Table events was 3,370, of which 400 were unique specialty crop producers and 672 were unique buyers (as noted below, some producers and buyers brought more than one person to each event). The remaining attendees included other producers, ag service providers, educators, lenders, non-profits and community members.

Farm to Table Trade Meetings

14 day long or afternoon workshops highlighted successful farmer-buyer relationships, focused on communication and business skills and provided networking opportunities. Networking happened throughout the event, but was also targeted during focused 10 minute mini-meetings or “speed dating” sessions between farmers and buyers. Partner, support and community organizations were invited to attend to provide resource booths and some events included farmers to provide a trade show component.

Farmer-Chef Connection

This project supported 3 F2C2 events, a day-long direct-marketing event for Washington Food Producers and Buyers. In addition to the facilitated and unstructured Networking Sessions that are always the heart of the F2C2 conference, the program included a keynote address, panel discussions and several breakout sessions on topics relevant to the audience. Event food service (a continental breakfast, lunch buffet and afternoon tasting) served as a showcase for Washington state products; each of the meals featured local ingredients donated by Washington producers and prepared by volunteer chefs working with catering staff. F2C2 also featured an Exhibitors Area for food producers, nonprofits and other organizations whose work supports the food system. SCC event staff worked to produce an event that would bring small-scale food producers together with buyers who are interested in supporting our local food economy.

Networking is at the core of building farmer-buyer relationships. Each year F2C2 continued to draw new producers and buyers along with returning attendees and supporters. This can be seen in the unique businesses that attended F2C2 over the 3 year grant spread sheet. There was a steady flow of first time attendees that is balanced by a core of returning business representatives. The mix keeps the networking sessions active with a steady supply of new producers and their products each year. In 2012, 189 Buyers and 154 Producers registered for F2C2 and participated in the speed networking sessions. As a survey comment states, “Still met new folks even after all these years.” It has been observed that even though there was formal networking that was timed and moderated; much work was accomplished around the periphery of the space. Some attendees preferred the more casual approach to making connections.

Meet & Greets

The MG program did an excellent job of continuously reminding local culinary professionals to keep thinking of new ways throughout the year to use locally grown specialty crops through 12 events. Anecdotally, organizers found these events resulted in a dramatic up-tick in the presence of these crops on local menus and significant increases in sales for local producers. Events put the spotlight on what chefs could create with pumpkins and winter squash, mushrooms, shelling beans, grapes, and other fresh vegetables and how chefs could use different preparations to utilize specialty crops like grilling, pickling and distilling.

Event Attendees	2010	2011	2012	Total	Average/yr
Total Attendees	1,092	1,132	1,146	3,370	1,123
Specialty Crop Producers	106	170	124	400	133
Buyers (no specific data for M&G events)	225	190	257	672	224

Coordinating trade meetings from all grant partners in this one project created a “clearing house” for farmer-buyer trade meetings in the State, which aided in effective collaboration and more efficient use of resources. The local food system is built upon a community of dedicated organizations, buyers and producers, working to encourage business growth.

Community partners, businesses and farmers took part in making these events address the unique needs of each community. Additional event partners and sponsors include, but are not limited to these below:

<ul style="list-style-type: none"> • OlyCap • Jefferson LandWorks Collaborative • Local Investment Opportunities Network (LION) • Slow Money NW • Whole Foods • Fort Worden State Park • Bon Appétit Restaurant Management Company • Northwest Agriculture Business Center • Grow Northwest Magazine • Hagen, Inc. • Community Food Co-op • WSU Extension (Jefferson, Benton, Whatcom, and Kitsap) • WSDA Farm-to-School • WSDA Small Farms & Direct Marketing • Occasions Events and Catering • Olympia Coffee Roasting • Lattin's Cider Mill and Farm • King County Public Health • NW Regional Food Hub • Kitsap Conservation District • Cedarbrook Lodge • Cedar Grove Packaging 	<ul style="list-style-type: none"> • Tacoma Farmers Markets • MultiCare Center for Healthy Living • Tacoma-Pierce County Health Department • Tacoma Regional Convention and Visitors Bureau • Healthy Communities of Pierce County • Northwest Leadership Foundation • Clark County Food System Council • Clark County Health Department • New Seasons Markets • FoodHub • Herban Feast • Grand Central Bakery • Oxbow Farm • Blue Danube Productions • Apres Vin • Klipsun Vineyards • Thundering Hooves • Gleason Ranch • Olsen Farms • 3 Sisters Cattle Company • TASTE • Kitsap Food & Farm Policy Council • Jefferson Farmers Markets
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A registration process was used to ensure that only specialty crop producers benefited from SCBGP funding. Grant partners found successful ways to support the non-specialty crop producer attendance through in-kind match, food donations, sponsorships, and in some cases charging a fee to cover the costs of their attendance.

GOALS AND OUTCOMES ACHIEVED

October 1, 2009 – September 30, 2012: Deliverables and Completed Activities
Deliverable 1: Farm to Table Workshop #1 <ul style="list-style-type: none"> • Whatcom Bounty Expo, December 3, 2009, Bellingham
Deliverable 2: Farm-to-Table Workshop #2 <ul style="list-style-type: none"> • NW Washington Farm-to-Table Trade Meeting, February 22, 2010, Mt. Vernon
Deliverable 3: Farm to Table Workshop #3 <ul style="list-style-type: none"> • South Sound Farm-to-Table Trade Meeting, March 22, 2010, Olympia
Deliverable 4: Farmer-Chef Connection Conference #1 <ul style="list-style-type: none"> • Farmer-Fisher-Chef Connection (2010 F2C2), March 1, 2010, Seattle
Deliverable 5: Farm to Table Workshop #4 <ul style="list-style-type: none"> • Olympic Peninsula Food and Finance Summit, December 3, 2010, Port Townsend
Deliverable 6: Meet & Greet #1 <ul style="list-style-type: none"> • Meet & Greet 1 - The Heirloom Shelling Beans, March 22, 2010, emmer&rye, Seattle

<p>Deliverable 7: Meet & Greet #2</p> <ul style="list-style-type: none"> • Meet & Greet 2, Restaurant Gardens & Farms, April 26, 2010, The Herbfarm Restaurant, Woodinville
<p>Deliverable 8: Meet & Greet #3</p> <ul style="list-style-type: none"> • Meet & Greet 3, Washington Spices, June 21, 2010, Elliott Bay Café—Seattle
<p>Deliverable 9: Annual Report</p> <ul style="list-style-type: none"> • Completed—Nov. 2010
<p>Deliverable 10: Farm to Table Workshop #5</p> <ul style="list-style-type: none"> • Northwest Farm-to-Table Trade Meeting, February 22, 2011, Bellingham
<p>Deliverable 11: Meet & Greet #4</p> <ul style="list-style-type: none"> • Seasonal Cocktails, July 18, 2011, Mistral Kitchen, Seattle
<p>Deliverable 12: Farm to Table Workshop #6</p> <ul style="list-style-type: none"> • South Sound Farm to Table Trade Meeting, April 11, 2011, Olympia
<p>Deliverable 13: Farm to Table Workshop #7</p> <ul style="list-style-type: none"> • Pierce County Farm-to-Table Forum, October 13, 2011, Tacoma
<p>Deliverable 14: Farm to Table Workshop #8</p> <ul style="list-style-type: none"> • Clark County Farm-to-Table Trade Meeting, October 25, 2011, Vancouver
<p>Deliverable 15: Farmer-Chef Connection (F2C2)</p> <ul style="list-style-type: none"> • Farmer-Fisher-Chef Connection, February 28, 2011, Seattle
<p>Deliverable 16: Farm to Table Trade Meeting #9</p> <ul style="list-style-type: none"> • Olympic Peninsula Farm-to-Table Trade Meeting, December 8, 2011, Pt. Townsend
<p>Deliverable 17: Meet & Greet #5</p> <ul style="list-style-type: none"> • Kimchi & Restaurant Pickling, August 15, 2011, Revel, Fremont
<p>Deliverable 18: Meet & Greet #6</p> <ul style="list-style-type: none"> • “Meat & Grape”, October 18, 2010, Herban Feast, Seattle
<p>Deliverable 19: Meet & Greet #7</p> <ul style="list-style-type: none"> • Octoberfest, October 10, 2011, Cedarbrook Lodge, Seatac
<p>Deliverable 20: Annual Report</p> <ul style="list-style-type: none"> • Completed—11/15/2011
<p>Deliverable 21: Farm to Table Workshop #10</p> <ul style="list-style-type: none"> • Northwest WA Farm-to-Table Trade Meeting, March 15, 2012, Bellingham
<p>Deliverable 22: Meet & Greet #8</p> <ul style="list-style-type: none"> • Pumpkins & Winter Squash, November 14, 2011, 6-8 p.m., Bastille, Ballard
<p>Deliverable 23: Farm to Table Workshop #11</p> <ul style="list-style-type: none"> • Central WA Farm-to-Table Trade Meeting, March 21, 2012, Yakima
<p>Deliverable 24: Farm to Table Workshop #12</p> <ul style="list-style-type: none"> • South Sound Farm-to-Table Trade Meeting, April 11, 2012 Lacey
<p>Deliverable 25: Farm to Table Workshop #13</p> <ul style="list-style-type: none"> • Kitsap Farm-to-Table Workshop, April 23, 2012, Bremerton
<p>Deliverable 26: Farm to Table Workshop #14</p> <ul style="list-style-type: none"> • Mid-Columbia Farm-to-Table Symposium, September 14, Richland
<p>Deliverable 27: Farmer-Chef Connection Conference #3; send follow-up exit surveys, March 2012</p> <ul style="list-style-type: none"> • Farmer-Fisher-Chef Connection, February, 27, 2012, Seattle
<p>Deliverable 28: Farm to Table Workshop #15</p> <ul style="list-style-type: none"> • Cancelled. Funds used for overall data collection and follow up with all Farm-to-Table attendees
<p>Deliverable 29: Meet & Greet #9</p>

<ul style="list-style-type: none"> • Mushrooms & Oysters, April 23, 2012, Melrose Market Studios, Seattle
Deliverable 30: Meet & Greet #10 <ul style="list-style-type: none"> • Cheese & Cider, May 14, 2012, Portage Bay Café and Catering, Seattle
Deliverable 31: Meet & Greet #11 <ul style="list-style-type: none"> • Grilling, August 13, 2012, Agua Verde Cafe & Paddle Club, Seattle
Deliverable 32: Meet & Greet #12 <ul style="list-style-type: none"> • Fresh Shelling Beans, September 17, 2012, Art of the Table, Wallingford
Deliverable 33: Follow-up, documentation and prepare final report <ul style="list-style-type: none"> • Completed—11/15/12

The performance goals were as follows and were all met:

- *To support WA farmers by providing them access to a network of buyers representing a diverse range of markets and buyers including chefs & restaurateurs, corporate and institutional food service and retailers.*
Over the course of three annual F2C2 events 189 unique Seattle area buyers attended the events, many of them returning annually.
- *To showcase locally produced foods to potential buyers.*
Events worked to showcase local products whenever possible. For Farm to Table events worked to incorporate local specialty crops into lunch or appetizers and in some cases even the tea. At F2C2 events, the ingredients and labor for these highly anticipated meals were almost entirely donated. The goal in seeking donations was not only to save money, but to create individual connections between the producers who grow or harvest the food and the chef who turns the raw products in to delicious meals. As demonstrated in MG events, working with a food item is the best way for a chef to consider its potential as a menu item. Chefs often stick with tried and true food producers whose product quality they know. The willingness of the producers and chefs to donate their product and time to produce these meals speaks volumes to the level of the community support these events have gained over the years. The value of the donated ingredients and labor for F2C2 2010 was \$17,150.00. In 2011 the value was \$14,000.00 and in 2012 the value came in at \$ 15,015.
- *To provide focused, efficient opportunities for buyers and sellers to meet through a “speed networking session and other structured networking activities.*
While the one-on-one connections were made between producers and chefs when putting together F2C2 or MG meals or during a break at the Farm to Table workshop, “speed networking” was an effective way for attendees to make new business connections and rejuvenate ones made at past events.
- *To facilitate discussion and problem solving relevant to local food markets at breakout sessions and panel presentations centered on topics such as local distribution networks, value-added products, marketing techniques, business skills for small scale producers, etc.*
Event agendas were planned with small producers in mind. As mentioned earlier in this report, small-scale food producers are often not only farmers, but also the processors, marketers, sales representatives and distributors of the food they produce. Taking one day off from work to attend a meeting is a large commitment of valuable time for these individuals. They take this time to attend events as they know they will expand their knowledge of the food industry, be informed on current issues and expand their business skills. A mix of keynote speakers, panels of buyers and farmers, group discussions and breakouts were used to allow for problem solving. Each event

derived content by looking at the needs of producers in the community, developed with input from local agricultural support organizations and farmers.

- *To foster a sense of community and shared vision between local food producers and buyers*
The presentations at events focused on the state of the local food network and economy as well as offered forums for discussion of common business challenges like processing and distribution. The speed networking sessions encourage producers and buyers to expand their range of business and make new sales relationships. Social time at meals and afternoon tasting sessions allowed time for the guests to discuss and consider all they had seen and heard during the event.

Long term goals were to:

- Increase local farm product sales to local retail and institutional buyers;
- Increase market share of locally grown and produced food;
- Facilitate specialty crop farmer-buyer sales connections in Washington;
- Provide a forum to discuss new and emerging sales and marketing strategies and issues for local agriculture; and
- Develop regional asset maps of producers and buyers.

While it was not possible to determine overall trends in market growth from only event attendees, survey responses reported suggest that both sales and purchases of locally produced food were likely on growth paths. On the purchasing side, surveys indicated there were noted increases in the number of buyers, both large and small, and an increase in the amounts of food being bought from Washington producers as a percentage of overall purchases. On the sales side, the number of producers was shown to be continually growing and that some of the largest producers are getting even larger. It also may be the case that Washington State producers who previously had focused on export markets are also becoming players in local markets.

It takes time to build business relationships. Some of the communities where events were held were just beginning to open communication between farmers and buyers about how to shorten the supply chain and increase the sale of products locally. In these cases, farmers and buyers were introduced to farm to table examples and successful strategies for the first time. It can also take time for small- to mid-scale producers to be able to accommodate communication, product volume and food safety needs of buyers. Organizers anticipate continual growth and movement toward more local sourcing and stronger relationships.

Grant deliverables were completed in entirety, with the exception of one Farm to Table workshop which was instead fulfilled through an overall final survey of Farm to Table Workshop participants. Project goals were accomplished (see above).

Established goals for this grant were to, “conduct a series of networking and educational opportunities to directly connect local producers with local food buyers, create new market relationships, and expand sales opportunities for farmers.” Events worked to provide education and build networking opportunities to aid in sales and connections.

The two measurable outcomes for this project were to:

- 1) Increase each producer’s sales by an average of \$800 per year; and
- 2) Increase the number of business relationships between local specialty crop producers, local food buyers, and supporting agricultural organizations by 750 per year (2 each for 375 participants).

Day of evaluations asked attendees about suggestions for future workshops, what was valuable to their business, what marketing and sales tips they learned and what barriers still remained. Post-event surveys asked attendees to share sales information and how many connections led to a sale for a one year period after the event they attended. Post-event surveys were sent out via email and online 6 weeks to 3 months after each event. Event participants in F2C2, F2T and MGs were surveyed and analyzed separately.

Farm to Table Workshops

Attendee response rate was low for the 6 week follow-up surveys. The best representation of data showing Measurable Outcomes comes from surveys collected post-event in 2011 where estimated sales were \$50,520, making the average sale for specialty crop producers around \$5,052. This average sale per specialty crop producer exceeds the measurable outcome of \$800 per specialty crop producer. Specialty crop producers that did not return survey data may have made additional connections and sales. Actual connections made by specialty crop producers alone were not well represented in survey data. In an attempt to capture more information about sales, organizers administered a final survey of F2T attendees at the end of this project. Out of 62 respondents, 25 said they were specialty crop producers. 16 reported sales of \$800 and above – 67% of specialty crop respondents. Overall survey data including responses from all attendees indicated there were 68 sales or agreements were made between farmers and buyers and 66 connections were made as possible follow-up buys. Attendees averaged one or more connection that led to a future sale. Lastly, respondents indicated that they had experienced a better community presence and stronger business connections (see chart above).

Farmer-Chef Connection

Measurable Outcomes for all three F2C2 events were based on the results of the annual F2C2 exit surveys, spring surveys and fall surveys. Viki Sonntag of EcoPraxis annually analyzed the surveys and reported the results. In the third year of survey analysis Sonntag's report offered the results of the F2C2 2012 surveys as well as comparisons of three years' survey results over the entire grant cycle. In addition, Sonntag expanded the analysis to include the survey results on file from two years previous to the grant cycle.

The goal of increasing participating producers' sales by an average of \$800 per year was harder to track even with the survey results as a reference point. The fall survey is conducted in October at the end of the growing season. This time was selected as it is after the busy summer-fall growing and harvest seasons, but before the holidays. For the purpose of grant reporting specialty crop producers sales were considered separately from other sales.

The fall survey asks for 'to date' through October. The average of specialty crop producers' sales to date in 2010 was \$970. In 2011 the average was \$624 and in 2012 the average was \$443. Over the three year grant cycle, sales to date for specialty crop producers averaged \$679. But sales for the year do not end in October and there should be additional sales made in the months of November and December. The three year average of sale per month over the annual survey's ten month period is \$67.90. It is conservative to estimate that sales would at least continue at this rate for November and December, increasing the year end average of sales for specialty crop producers to \$815 and meeting the grant's goal. Connections far exceeded initial expected outcomes of 2 per producer.

Which of the following educational and networking benefits for your business do you attribute to the Farm-to-Table Trade Meeting? (Check all that apply.)

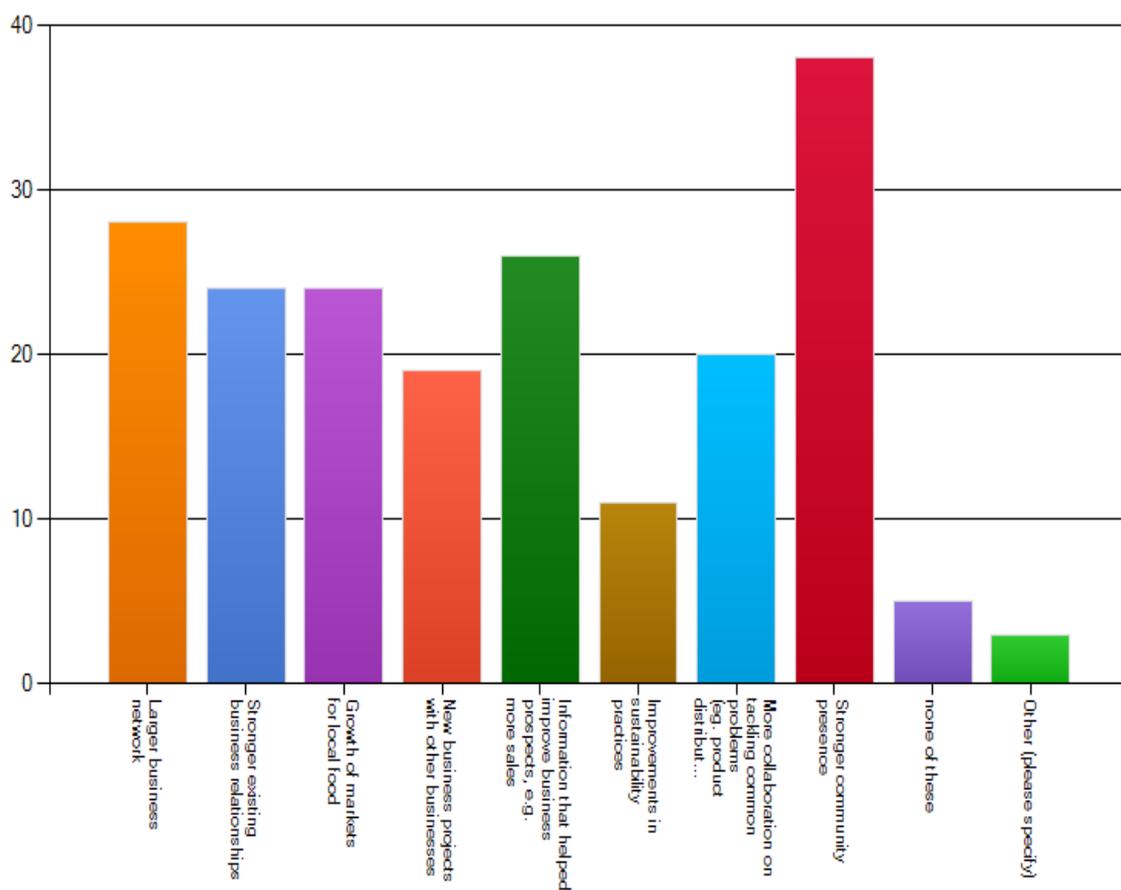


Table 3: Average Number of Connections Made at Event

	Average Number of Connections That:			Total number of connections
	Led to a sale or purchase	Resulted in an agreement (either formal or informal) for making a sale or purchase later this year	Are likely prospects for follow-up	
All	1.3	1.3	3.1	5.7
Buyers	1.2	1.3	2.6	5.1
Producers	1.3	1.4	3.6	6.3
Specialty Crops Producers	1.9	1.8	3.2	--

BENEFICIARIES

Current and future specialty crop producers are benefiting from increased information, relationships, exposure to buyers and increased buyer understanding of local products.

Hosting these events each year benefits small-scale local and regional food producers by offering them a space that is specifically for coming together to network and share ideas. These events are not trade shows with slick promoters and salespeople, but a gathering of small scale food producers who want to do better. They are proud of their work and the food they produce. They have stories to tell and lessons to share. Sales numbers are not huge and the volume of product moved may seem inconsequential, but to this target audience, a few new business connections can mean the difference between paying the bills and going out of business.

Event Attendees	2010	2011	2012	Total	Average/yr
Total Attendees	1,092	1,132	1,146	3,370	1,123
Specialty Crop Producers	106	170	124	400	133
Buyers (no specific data for M&G events)	225	190	257	672	224

Total attendance at all Farm-to-Table events was 3,370, of which 400 were unique specialty crop producers and 672 were unique buyers (as noted below, some producers and buyers brought more than one person to each event). The remaining attendees included other producers, ag service providers, educators, lenders, non-profits and community members.

The grant proposal anticipated event participation would be approximately 1,125 specialty crop producers and that these new sales connections would result in an estimated \$1 million dollars per year in additional specialty crop farm income. These estimates were based on documented sales resulting from previous Farmer-Chef Connection conferences, Farm-to-Table workshops and specialty crop-focused Meet & Greets.

The number of participants that identified themselves as first time attendees decreased from 51% to 26% over the grant period (among all participants). Repeat attendance is critical to initiating, building and maintaining business relationships between specialty crop producers and buyers. However, the number of new connections and new sales opportunities for longer-term attendees may be lower than for first time attendees, as sales figures only capture the value of new relationships not previous or on-going relationships. Therefore, it is likely that total sales for specialty crop producers attending multiple events will be understated. Find ways to increase overall attendance by new specialty crop producers and continue to expand the diversity of food buyers.

Sales data collected during the three-year project period indicate that annual food-related sales for all producers in attendance totaled nearly \$3.5 million or an average of nearly \$1.2 million per year. For buyers, purchases over the same period totaled nearly \$5.4 million or an average of nearly \$1.8 million per year. Because there is overlap between sales and purchases, the numbers cannot be combined. However, with the total between \$3.5 and \$5.4 million, it is clear that Farm-to-Table events represent a significant opportunity to increase producer income. It should also be noted that no additional multiplier effects have been calculated from new sales, understating the total economic impact to the region.

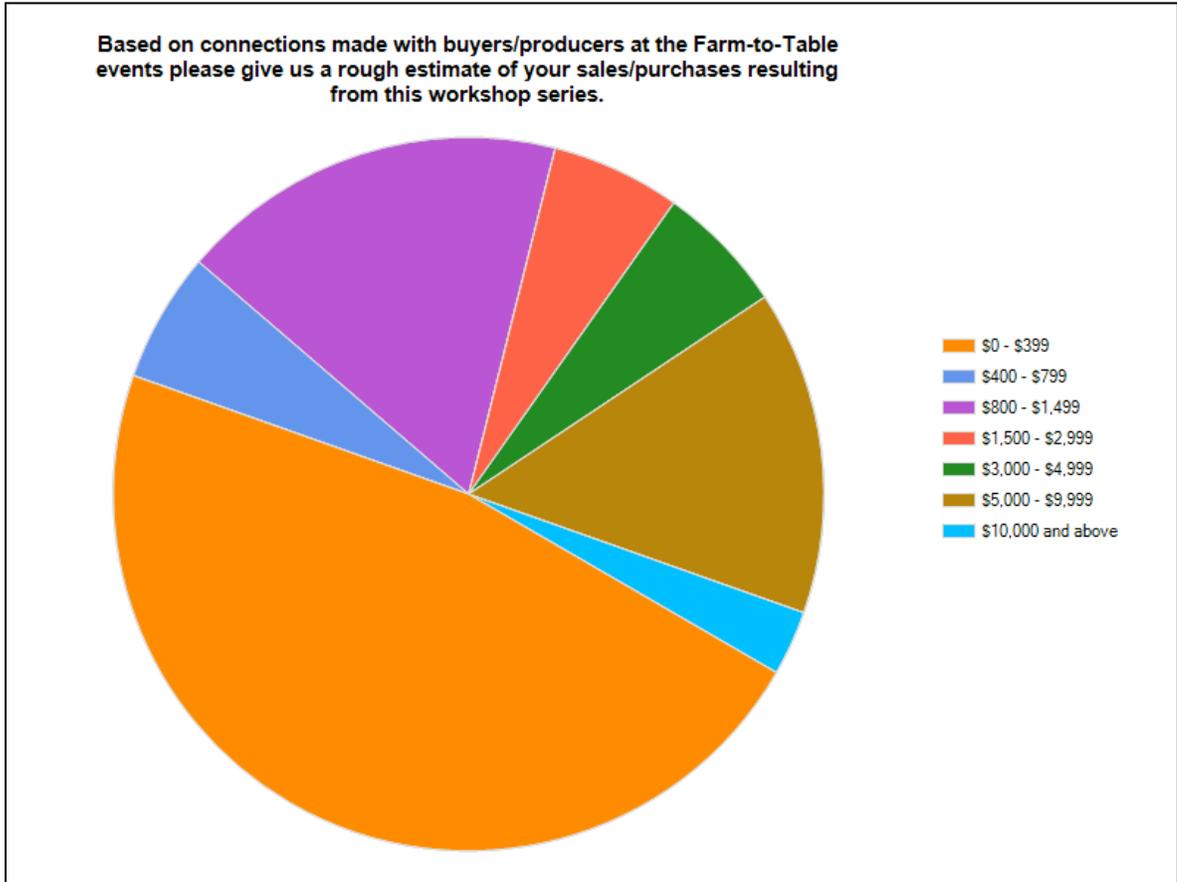
Average Annual Food Related Sales/Purchases*	2010	2011	2012	Total	Average
Buyers	\$2,944,200	\$1,568,227	\$866,086	\$5,378,513	\$1,792,838
Producers	\$802,243	\$861,463	\$1,788,377	\$3,452,083	\$1,150,694
Average Value of To-Date Sales for Specialty Crop Producers	2010	2011	2012		Average
All Specialty Crop Producers	\$970	\$624	\$459		\$684
Specialty Crop Producers Detailing Connections	\$1,576	\$1,373	\$510		\$1,153
Average:	\$1,273	\$999	\$485		\$919
Average Value of To-Date Purchases for All Buyers	2010	2011	2012		Average
All Buyers	\$2,054	\$2,036	\$2,642		\$2,244
All Buyers Detailing Connections	\$3,240	\$2,601	\$3,170		\$3,004
Average:	\$2,647	\$2,319	\$2,906		\$2,624
Estimated Annual Value of Connections Made	2010	2011	2012	Total	Average
Buyers	\$2,583,830	\$146,592	\$146,592	\$2,877,014	\$959,005
Producers	\$1,227,486	\$95,108	\$95,108	\$1,417,702	\$472,567
Average Number of Connections	2010	2011	2012		Average
Buyers	6.4	4.8	5.1		5.4
Producers	6.3	5.3	6.3		6.0
Specialty Crop Producers	9.6	4.5	6.9		7.0
* Calculations do not include any value to likely prospects for follow-up or the value of ongoing sales relationships between producers and buyers past the event year. This likely underestimates the total value of sales.					

For the initial grant application, it was assumed that each specialty crop producer would realize average sales of \$800 (based on attendance and sales assumptions). For the grant period, specialty crop producers realized average sales of \$919, more than what was initially estimated. It should be noted that this average figure does not include any value to likely prospects for follow-up or the value of ongoing sales relationships between specialty crop producers and buyers past the event year. This likely underestimates the total value of sales. Exploring ways of better capturing year-of-event and on-going business relationships (in terms of sales) would help solidify the numbers. Other suggestions presented here for increasing attendance and more complete counting of specialty crop producers should also help.

Beyond business connections and sales made, a very critical element of Farm-to-Table is networking. Not only among buyers and sellers, but with the broad diversity of agriculture, marketing support, lenders, institutions and other organizations that attend. The events meet a critical need in helping farmers just starting out with ideas about production, marketing, technical assistance and other support services - all critical in helping them establish sustainable business enterprises – but also critical in helping current farmers adapt to changing market demands. Also important is providing information on

issues that may affect the sustainability of their business as well, such as emerging food safety requirements, etc.

Farm to Table Workshop attendees were asked to complete a final survey to determine their sales based on one or more workshops they attended. 47% of all respondents (25 producers) indicated they had sold more than \$800 as a result of attending a workshop and making sales connections.



Farmer-Chef Connection

The report written by Viki Sonntag best captures the economic impacts of F2C2. But as Sonntag offers in her report much of the value of F2C2 is not quantifiable, "...it should be noted that this calculation does not reflect the net value of connections made at the event. It is assumed that some portion of the connections made at the event would occur without the event. However, the added value of the event to participants is that it facilitates and lowers the cost of making and maintaining these connections."

Estimated Annual Value of Connections Made at 2012 F2C2 Event

Annual Value = (Average value of connections) * (1- % reduction in value at 8 months)*
(average number of connections made that led to sales or purchase or resulted in an agreement) *
number of buyer or producer representatives * discount factor

Producers: $(\$443) \cdot .95 \cdot (2.7) \cdot (93) \cdot 0.75 = \$95,108$

Buyers: $(\$2,036) \cdot .90 \cdot (2.5) \cdot (97) \cdot 0.75 = \$146,592$

LESSONS LEARNED

- Total specialty crop attendance at each event was calculated based on the number of unique farms (and unique buyers). While each may have had multiple people present, only the farm or buyer was counted. For example, Growing Washington attended the 2011 NW Washington Farm-to-Table trade meeting and brought 3 farmers. But Growing Washington only counted as 1 specialty crop producer. The same goes for Haggen Foods, which attended the same meeting and brought 5 buyers. While total attendance captures all participants, the number of specialty crop producers is understated. The number of unique farm and food buying businesses is used in calculating average sales; including all members from any farm or food buying entity would dilute the sales figures. Reporting can be improved by counting all specialty crop producers as well as the number that are unique.
- One remaining Farm to Table event was not accomplished due to CHC staffing change, readiness of community partners and timing. CHC changed Program Managers in January 2011. This was during prime workshop planning season, November to March, when the main specialty crop harvests are completed and farmers have more time to attend events. CHC worked to complete the one remaining workshop, but was unable to achieve this due to lack of community readiness and partnership. Successful and sustainable Farm to Table events rely heavily on working with producers and support organizations in the community in which CHC is trying to serve. These events work to create connections that go beyond the one event and grant lifecycle with the intention of building capacity within those communities to carry on these efforts. CHC did reach out to several communities who had expressed interest or were planning events where Farm to Table would be appropriate; however, timing of the remaining event was not possible by the end of the grant cycle. CHC is continuing to pursue these connections and organize events with communities who are interested.
- The nature of Farm to Table connections makes it difficult to separate specialty crop producers from non-specialty crop producers. Buyers, processors, distributors, support organizations and even consumers are vital attendees at these events because they are the other half of the solution. Specialty crop producers benefit from non-specialty crop producers coming to the events. Grant partners found successful ways to support non-specialty crop producer attendance through in-kind, food donations, sponsorships and in some cases, charging a fee to cover the costs of their attendance.
- There is a lot of demand for specialty crops.
- Events were held on weekdays to attract buyers. Depending on the community and local events, market days were avoided.
- Groups of regional producers have increasingly come together to form “food hubs,” aggregating products, selling wholesale and being able to meet needs of larger distributors and buyers. New types of retail outlets have formed, such as hybrid Co-op models.
- Some communities have come up against larger barriers of processing, distribution and demand as they have continually scaled-up their operations and relationships.
- There is a great potential to work more closely with Latino and other minority farmer groups.

- No event was the same; each event had its own challenges and successes. As much as staff plans and prepares, staff need to be flexible.
- Producers and buyers who succeeded in the “speed networking” tended to be outgoing while those who were shy had less success.
- Networking sessions might have been more efficient if done over rectangular tables that allowed people to sit face to face rather than around large tables that seat eight guests.
- Providing a time and space for small-scale producers to meet with buyers is not something that can be easily quantified. People who work to produce food have schedules that don’t easily allow for them to meet with prospective buyers or with their peers to compare notes on daily challenges. The distance between farms is often great making meeting difficult. These events allowed for both of the conversations to happen.
- A person who excels as a food producer may not have similar success with marketing their own products. Coaxing food from the earth or fish on to a boat are both very different than promoting and marketing a product. It is a lot to expect one person to do both of these jobs or have the skills required of each of the jobs.
- Distribution is still one of the largest hurdles for small-scale producers. Each year the topic was discussed and the problem remains.
- Events were found to be great opportunities for not only existing farm operations, but also for perspective new specialty crop producers to learn more about new markets and how to connect with the other producers, buyers and community support organizations in their communities.
- Events attracted specialty crop processors looking to value-add specialty crop products, further extending the pool of interested buyers.
- Coordinators were elated with the enthusiasm met in communities where agriculture existed on a much larger, commercial or commodity scale. For instance, producers in the South Central WA region said, “we’re too big to be small and we’re too small to be big,” demonstrating a need to find more niche markets and sell more directly to consumers and buyers.
- Connections were made and stronger networks were inarguably built; however, the goal to increase participating specialty crop producers’ sales by an average of \$800 per year was difficult to track.
- It was difficult to get high participation in follow up surveys. Day of surveys were collected on paper and as attendees left; however, follow up surveys were required to attempt to capture post-event sales and connection data.
- The low response rate to the spring and fall surveys made for a weak data set to mine for quantitative information. Sales numbers are often viewed as private information and it may have been off putting to some to reveal this information even though confidentiality was assured.
- The fact that attendees did not respond to the survey may simply mean they were busy with the detail of running a business. Often email communications are prioritized down to what must be dealt with to keep the business going. If you are an independent food producer, completing a survey might not make the cut no matter how much you benefited from attending a workshop.
- The increased number of exit survey responses was a result of handing out the surveys before the closing remarks and allowing five minutes for people to fill them out. Building time into the agenda for this to happen paid off with the highest number of exit surveys complete over the three year cycle.
- The design of the survey is important. In the case of the F2C2 results, it is the feeling of SCC and Sonntag that sales were better than reported by the surveys we analyzed. The annual decrease in to date sales was considered and discussed by SCC and Sonntag. The survey that was used only asked for information on sales generated from *new* connections made at F2C2. The survey did not inquire about sales brokered at F2C2 between producer and their existing clients. One of the comments that was often made by F2C2 guests was that they welcomed the networking time at F2C2 to not only make new connections, but also to make contact with current business partners. A suggestion for future surveys would be to include a question about existing sales relationships.

- Relationships take time to build and nurture. For instance, directly quantifying the exact impact of the Meet & Greets was a challenge. Producers often found it hard to draw the direct links between new sales and connections made at these events, and often chefs would leave these events inspired, reporting later that they added these local crops to their menus, but not necessarily from the specific producers at these events. Thus, while the overall result is one of a significant expansion in the use of local ingredients by local chefs, it is hard to tangibly prove the role the Meet & Greets played. Still, producers continue to volunteer their time and product to make these events happen, and chefs continue to attend, and they all express that they see significant value in the events toward building an expanded local food economy, regardless of our ability to track the specific impact these particular events are having on it.

CONTACT PERSON

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ADDITIONAL INFORMATION

Donations and in-kind matching was given in the form of staff and organizing time, local products, audio and visual equipment, travel expenses, venue rental, speaker fees, catering services, linens, video and media production, and more. Total cash and in-kind match came to **\$167,985.22**.

Media, photos and video samples:

- Farm-to-Table Trade Meeting Photos & Announcements:
<http://www.flickr.com/photos/52574920@N08/>
- Interview for Rural TV: TV For a Growing World, 9/11/12 about Tri-Cities Farm-to-Table Event:
<http://myruraltv.com/?q=news/phoner-sarah-wilcox>
- Tri-Cities Herald, 8/23/12: <http://www.tri-cityherald.com/2012/08/23/2071421/farm-to-table-event-for-sept-14.html>
- Grow Northwest Magazine, 3/2/12: <http://www.grownorthwest.com/2012/03/farm-to-table-trade-event-sustainable-ag-conference-coming-up/>
- F2C2 2011 Photos:
<https://picasaweb.google.com/114677509525596970523/SeattleChefsCollaborativeF2C22011>
- Seattle Chefs Collaborative Facebook Albums for Meet & Greets and F2C2 2012:
<http://www.facebook.com/media/set/?set=a.10150640626023955.406896.332210008954&type=3#!/seattlechefs>

Websites:

- Cascade Harvest Coalition: <http://www.cascadeharvest.org/programs/farm-table>
- Seattle Chefs Collaborative: <http://seattlechefs.org/event/seventh-annual-farmer-fisher-chef-connection>
- Sustainable Connections: <http://sustainableconnections.org/news/sc-press-releases/calling-all-food-buyers-and-producers-2013nw-farm-to-table-trade-event-march-15>

END OF REPORT