FINAL PROJECT REPORT

Project Title: Cherry Fruit Fly Control Options (CH-06-603)

PI: Timothy J. Smith
Organization: Washington State University
Telephone: **509-667-6540**
Email: smithtj@wsu.edu
Address: 400 Washington
City: Wenatchee
State/Zip: 98801

Cooperators: None.

Other funding Sources

Name: Dow, DuPont, Bayer, Cerexagri, Chemtura, MGK, Gowan.

Amount awarded: $54,050 total over 3 years.

Total Project Funding:

Budget History:

Item	Year 1:	Year 2:	Year 3:
Salaries	$10,773	11,916	12,393
Benefits	4,094	4,051	4,214
Wages			
Benefits			
Equipment			
Supplies	300	300	300
Travel	1,940	1,869	1,869
Miscellaneous			
Total	$17,107	18,136	$18,776
3 Year Total			**$54,019**

Introduction and Justification

At the time this project was initiated, cherry fruit fly was identified as the top priority in the TFRC Cherry Research Committee yearly priority setting sessions. The objectives of this project were chosen because the carbamate and organophosphate class insecticides available at the inception of this work were (and continue to be) under regulatory pressure. This impending loss of key CFF control products could be offset by the discovery and demonstration of safe and effective new CFF control materials and methods. This project is the continuation of an 11 year effort, with financial support from the Washington Tree Fruit Research Commission for the past 5, to reach the objectives below as first stated in 2003.

Summary of Results:

Objective 1: Identify new conventional and organic cherry fruit fly control products and methods.

! Fifteen products within eight pesticide classes were identified as having potential for these trials, ten conventional and five organic, most had never been tested for efficacy on cherry fruit fly.

! A new method of cherry fruit fly control (GF-120 NF bait, ATV application) was tested for the first time, anywhere.

Objective 2*:* Assess these new insecticides and methods for cherry fruit fly control.

! All of the conventional products were effective, some equal or superior to standard products available in past decades.

Superior: imidacloprid (Provado), Delegate, Success and Entrust, Altacor, a numbered product "Z," and, based on one year's data, indoxacarb (Avaunt) and pyriproxyfen (Esteem).
Very good: GF-120 bait, Assail, Calypso, Actara.
Good, probably…: Rimon, Agri-Mek.

! Of the five organically acceptable products tested, two proved to be far superior to past choices.

Superior: GF-120 NF fruit fly bait, and Entrust, both of which have spinosad as their active ingredient. As fruit flies rarely develop pesticide resistance, this should not be a problem.
Good, but impractical: High rate per week of summer weight horticultural oil.
Fair: pyrethrum (Pyganic).
Poor: azadirachtin (neem, Aza-Direct)

! A product (imidacloprid, "Provado") was proven to be an effective alternative to the EPA-threatened dimethoate as an after-harvest "clean-up" spray. Two other products (Assail and Calypso) may also be adequately effective, though slightly less effective than imidacloprid.

Objective 3: To work toward the registration of effective new CFF control products.

! This project has had a positive effect on the registration and adoption of the following cherry fruit fly control materials:

Major effect: Success, GF-120, Entrust, Delegate, Assail.
Significant contribution: imidacloprid (Provado, various other brands), Avaunt.
Contribution: Actara.
Significant effort expended, but not registered yet: Altacor, Rimon, Calypso

Impact of this work:

! This project first recognized the potential and demonstrated the efficacy of GF-120 Bait, applied by ATV as a cherry fruit fly control. Adoption of this new technology by PNW Cherry growers has decreased yearly cost of controlling CFF by about $2.5 million each year. In the past four seasons since registration, total savings are about $6.7 million. These estimates are based on:
  - Reduced application costs, labor, fuel & tractor and sprayer, of about $20 / acre.
  - Lower spray material costs, at $20 / acre, or more.

! Other potential benefits of this technology include a 200,000+ gallon yearly fuel savings due to ATV application vs. tractor/sprayer. The rising cost of fuel increased the impact of this project by $500,000 / year in reduced grower fuel costs over the past two years.

! This bait may now be the most commonly used insecticide on Washington cherries, while it is used by virtually all organic cherry growers, by far the greatest acreage treated is in conventional orchards.

! Three products were identified as alternatives to dimethoate as after-harvest "clean-up" sprays. The EPA-proposed lower rate of dimethoate was found to be less effective. Growers now have "softer" choices (imidacloprid/Provado, Assail), making it more likely to be done. In the long term, this should reduce CFF numbers in a region the season after treatment, lowering risk of control failure to all.

! Some products were removed from organic grower options due to their failure to perform well in these trials. Azadirachtin (neem), previously recommended for organic control of CFF, was proven ineffective. Pyrethrum was found to be suppressive, but not sufficiently effective.

! In 2003, cherry fruit flies were commonly found in many organic cherry orchards. In 2007, industry leaders announced that this pest was "no longer a problem."

! Cherries can now be safely grown by any grower as "organophosphate-free."

! Black cherry aphid and leafrollers can be brought under control during the late spring as a side benefit of using some of the products newly registered as CFF controls (imidacloprid/Provado, Assail).

! Cherry fruit fly has recently dropped from #1 on the TFRC cherry committee priorities list to nearly last place. Growers are advised to avoid complacency when planning their cherry fruit fly control program. New tools will not work without proper use.

Results and Discussion:

Note: These data are reported as results of experimental trials. While many of these products can be legally used on cherries, some are not legal, and may never be legal. Always check to see if sweet cherry is listed on the product label prior to use of any pesticide.

Conventional Product in Trials and Rate/A	Years in Trial	Total Trees / Total Sites	Total Fruit Inspected	Total Larvae Found	Larvae Per 1000 Fruit
Untreated Checks	**2003-07**	**22 trees 22 sites**	**16,315**	**7,081 (43% Average)**	**434**
2008 Untreated Check	**2008**	**1 tree 1 site**	**1,000**	**573 (57% Average)**	**573**
Provado 3 - 6 oz. (imidacloprid)	**1999, 2003 04, 06, 07, 08**	**68 trees 34 sites**	**32,600**	**1***	**0.03**
Success (spinosad) **2, 4, 6 or 8 fl.oz 7 Day Intervals**	**1997, 98, 99, 2002**	**37 trees 5 sites**	**7,500**	**13** All in low rate trials**	**1.73**
Altacor (rynaxypyr)	**2002, 2005 2006**	**35 trees 31 sites**	**30,800**	**20** All in Low rate trials**	**0.65**
Delegate 4 oz. (10 day spray interval)	**2005, 2006**	**15 trees 15 sites**	**15,000**	**0**	**0**
Delegate 3 oz. (***10 day spray interval***)	**2008**	**4 trees 3 sites**	**4,000**	**0**	**0**
Delegate 4.5 oz. (***14 day spray interval***)	**2008**	**2 trees 2 sites**	**2,000**	**0**	**0**
Secret Product Z	**2005, 2006**	**11 trees 11 sites**	**11,000**	**0**	**0**
Rimon (novaluron)	**2005, 2006**	**7 trees 7 Sites**	**7,000**	**13**	**1.86**
Esteem 5 oz. (pyriproxyfen) 10 day intervals	**2008**	**2 trees 2 sites**	**2,000**	**0**	**0**
Agri-Mek 10 oz. (abamectin) 10 day intervals	**2008**	**1 tree 1 site**	**1,000**	**23****	**23**
Agri-Mek 20 oz. 10 day intervals	**2008**	**1 tree 1 site**	**1,000**	**1**	**1.0**
Avaunt 4.5 oz. (indoxacarb) 10 day intervals	**2008**	**4 trees 4 sites**	**4,000**	**0**	**0**

Table 1. Summary of cherry fruit fly control options trial data1999 through 2007, with most 2008 Year Data separated. * Single larva found when treatment tree was adjacent to a highly infested tree. **"Failures" were generally due to intentional research efforts while testing rates and spray intervals; the rate was too low, or interval too long, or both.

Organic Product in Trials	Years in Trial	Total Trees / Total Sites	Total Fruit Inspected	Total Larvae Found	Larvae Per 1000 Fruit
Untreated Checks	**2003-08**	**23 trees 22 sites**	**17,315**	**7,888 (46% Average)**	**456**
Aza-Direct / Neem (azadirachtin) Every 7 days	**2004**	**12 trees 6 sites**	**2000**	**102**	**51**
GF-120NF Bait (every 7 days) **Full Rate of 20 fl.oz/A**	**2002, 03, 04, 05, 06, 07, 08**	**128 trees 51 sites**	**46,400**	**2***	**0.04**
GF-120NF Bait – 7 days **Half Rate of 10 fl.oz/A**	**2007**	**3 trees 3 sites**	**3000**	**27***	**9.0**
GF-120NF Bait, 1st year on Extreme Infestations 20 fl.oz/A every 7 days	**2007**	**13 trees 2 sites**	**1000 1000**	**12 0**	**12 0**
GF-120NF Bait 20 fl.oz/A **every 10 days Not near CFF source**	**2008**	**5 trees 5 sites**	**5,000**	**0**	**0**
GF-120NF Bait 20 fl.oz/A **every 10 days Near CFF source**	**2007, 2008**	**3 trees 3 sites**	**3,000**	**36****	**12**
Entrust 1.9 oz @ 10 Days Interval (spinosad)	**2003, 05, 06, 2007**	**25 trees 16 sites**	**15,400**	**0**	**0**
Entrust 1.0 oz @ 10 Day Intervals	**2007**	**4 trees 4 sites**	**4,000**	**1***	**0.25**
Horticultural Spray Oil 1%, 300 gpa, @ 7 days	**1999**	**4 trees 1 site**	**800**	**6**	**7.5**
Pyganic 5 @ 7 days (pyrethrum)	**2006**	**6 trees 6 sites**	**6,000**	**10*****	**1.67**

Table 2. Organic CFF Control Product Summary: *Control failure due to research, while testing rates and intervals. **Untreated infested trees nearby. ***Five of six plots had low numbers of larvae in fruit, despite moderate CFF pressure, indicating that the product is suppressive, but not sufficiently effective.

After-Harvest Treatments

Three materials were demonstrated as effective for control of cherry fruit fly larvae inside the fruit, as possible alternatives for post-harvest dimethoate. One product, abamectin, was not adequately effective in the 2008 after harvest test.

After-harvest Product	Rate	Larvae Emerged / 1000 Fruit	As Percentage of the Untreated
Dimethoate 267	64 oz./200 gal./A	112	8.8
Provado 1.6F	6 oz./200 gal./A	64	5.0
Provado 1.6F	8 oz./200 gal./A	52	4.1
Agri-Mek 0.15 EC	10 oz./200 gal./A	608	47.8
Agri-Mek 0.15 EC	20 oz./200 gal./A	624	49.1
Untreated	0	1272	100

Table 3. A summary of 2008 after-harvest larva control trials, products applied to heavily infested cherries for control of larvae inside of fruit on the tree.

After-harvest Product	Rate/Acre	Number of Tests	Larvae Emerged per 1000 Fruit	As Percentage of the Untreated
Dimethoate 267	64 oz.	4	40	3.3
Dimethoate 267	48 oz.	2	48	4.0
Provado 1.6F	4 oz.	1	132	11.0
Provado 1.6F	6 oz.	2	84	7.0
Provado 1.6F	8 oz.	4	28	2.3
Calypso SC 480	8 oz.	2	46	3.8
Assail 70WP	2.3 oz	1	252	21.0
Assail 70WP	3.4 oz.	3	84	7.0
Agri-Mek 0.15 EC	10 oz.	1	608	50.6
Agri-Mek 0.15 EC	20 oz.	1	624	52.0
Untreated	0	4	**1201**	**100**

Table 4. A summary of 4 years after-harvest larva control trials, products applied to heavily infested cherries for control of larvae inside of fruit on the tree.

All after-harvest products tested appear to be very acceptable replacements for dimethoate, the only product currently recommended for controlling larvae in fruit remaining on harvested trees. The "post-infestation effect" of imidacloprid (Provado, etc.), acetamiprid (Assail) and thiacloprid (Calypso) may give products with this class of chemistry an advantage as a pre-harvest product, as application may control newly hatching eggs or larvae that may have slipped through earlier control programs. At this time, dimethoate is not a popular pre- or post-harvest choice, as it sometimes causes leaf yellowing, necrosis and drop. Many growers avoid using it.

Executive Summary:

Significant Progress and outcomes: Cherry growers now have a number of excellent control product choices, with a few more likely to come, and a new method of control due to this project. It is now possible to grow cherries free of any cherry fruit fly larvae without using any product listed in the 2003 WSU spray guide. While all pesticide use will continue to be a public concern, the products this cherry industry is now turning to for CFF control are judged to have low impact on the environment and the applicator. Especially important with a crop that must be protected from a key pest up to and through harvest, the alternative products registered with the help of this project are of very low toxicity, and, compared to traditional products, are used at very low rates per acre.

We now have effective control options for organic control of CFF, which had not been the case from the time rotenone was dropped from the organic use list until 2005, when GF-120 NF became available.

The options made available through this project should remain useful for decades, as fruit flies, as a group, do not tend to develop resistance to pesticides, even when exposed to the same product for many generations (example: the yearly near-universal use of ULV malathion for decades in The Dalles, Oregon.)

Future Directions: While there are always new ideas to work on, I believe the original three objectives had been achieved to a degree that relieves the impact of losing older class CFF control materials. While there are a few new products yet to be fully tested, most of those with an interested registrant company or organization have been evaluated.

I intend to continue working on control of cherry fruit fly, but at a reduced level, supported by grants from various sources, carrying forward some further investigations on current new products and waiting for new opportunities to develop. If any really significant technology or products develop, and I need the financial assistance of Washington and Oregon cherry growers to test these new possibilities, I will bring a new proposal to you and try to justify my plans and requirements.

Thank you for all of your support during the course of these trials. Your financial support led to the rapid development of the various cherry fruit fly control options. Without your support, much of the work would not be completed or may have never been initiated.