

**Project title:** Organic Cherry Fruit Fly Control with Spinosad (Enrust, GF-120 bait), Compared to a Conventional Provado Standard and an Untreated Check.

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### **Introduction and Justification**

Cherry fruit fly has been identified as the top priority in the Washington State Tree Fruit Research Commission Cherry Research Committee yearly priority setting sessions. Until the recent availability of organically acceptable formulations of spinosad, cherry fruit fly control was becoming ever-more difficult in Washington State organic cherry orchards, and failure to control was an increasing problem.

### **Significant Results Summary:**

- Entrust, applied at seven or ten day intervals resulted in 100% cherry fruit fly control. Seven day spray intervals are recommended for this product.
- GF - 120 bait application resulted in 100% Cherry Fruit Fly control on four previously infested sites treated since 2003, five sites treated since 2004 and three sites treated starting in 2005. There were no larvae found in 12,000 fruit sampled in 2005 from these bait-treated sites. Since the authors' bait trials started in 2002, on 35 trial sites, two larvae have been found in 18,750 fruit samples. These two single larvae were found after the first treatment season on trees that had been nearly 100% infested the previous year. No larvae have been detected in fruit on trees that have been treated for two or more seasons.
- Untreated cherry trees in this 2005 project had 30 to 136 percent fruit infestation.

### **Methods and materials:**

Small CFF infested sweet cherry orchards were used as sites for the 2005 replicated trials. In total, 72 infested cherry trees on 22 sites, plus five individual isolated untreated checks have been included in this test product project this year. The cherry trees on these sites were documented or reported as infested with fruit fly, and current season adult trap catch clearly indicated that all trees were infested. The test trees were volunteered for use by the owners as test subjects, with a signed agreement that the fruit could not be consumed if treated with unregistered products. In return, the cherry tree owner was assured "clean" trees next year, and had access to the Provado and Entrust "check" tree fruit for immediate consumption.

Isolated abandoned cherry trees were left as "unsprayed checks" to document the relationship between prior and current season trap count and the degree of fruit infestation. One of the unsprayed trees developed 136 percent infestation in 2005, a new local record. (339 cff larvae were taken from 250 fruit.)

All test sites were monitored with the standard Trece baited AM yellow sticky 9 x 11 inch traps to document adult presence on the trial trees and 2005 potential for infestation of fruit. Spraying usually

greatly reduced trap catch numbers, but did not eliminate adults. Adult trap catch is common on treated highly infested trees, as some immature adults find the trap before the treatment control them. The trial applications began May 19, three days after the first CFF adult was trapped in the area. Sprays were applied at ten-day intervals from that date until the normal harvest maturity, which occurred in late June or early July. A total of four, 10-day interval sprays were applied during the treatment period. About five to seven weekly applications of bait were made. At harvest-time, a 1000 cherry sample was collected from each replicate and placed into cold storage. The sites were treated with GF-120 Bait for 2-3 weeks after harvest, as fruit remained unpicked on the trees treated with unregistered products.

GF-120 bait treatments were applied weekly, and reapplied after rain on some of the sites. Fruit samples were taken late in the harvest time period so that any infestation would be more detectible.

The test fruit was checked for larva with the Washington State Department of Agriculture standard brown sugar solution method for the detection of CFF larvae in large batches of fruit. In this extraction technique, cherries are crushed carefully, then place in a solution of seven pounds of brown sugar dissolved in five gallons of water. The specific gravity of CFF larvae is less than that of the solution, which causes them to float to the surface of the cherry/syrup mixture. The light colored larvae are relatively easy to observe floating on the dark surface, even when they are in their first instar. This method assured that large numbers of fruit could be sampled, assuring detection of even low numbers of small larvae. Larvae were easily detected in fruit taken from untreated check trees. Some samples of fruit were also suspended on a grate over sand to check for naturally emerging larvae. This larva detection method did not appear significantly more accurate than a carefully run brown sugar solution larval extraction technique.

**Application:** All materials except the bait were applied with a backpack air-blast/mist sprayer in about 100 gallons water per acre. All rates and carrier volumes were adjusted relative to tree size. The “post-harvest” GF - 120 bait applications were treated with a 1:3 bait to water mix applied with hand-held “window washer” squirt bottles adjusted to apply a solid stream of mixture. Rate per acre was adjusted by varying the amount of mixture that was applied relative to the size of each test tree. Bait was re-applied after significant rainfalls. Heavy dew would likely dissolve the bait speckles, possibly leading to control failures, but heavy dew is rare in North Central Washington during June and July, so was not monitored.

## **Results:**

Entrust 80WP was entirely effective in the trials, which is consistent with past trial results. However, the 2005 trial was at ten-day intervals, rather than the seven day intervals tested in past seasons, and now commonly recommended. The ten day interval has not been extensively tested by the author. Control of this pest by Entrust, or Success, on a ten day interval would lower the cost of treatment, once the orchard population of CFF had been driven down to normal low levels. Further tests may be required before the interval recommendation is increased, as interval between CFF cover sprays is a critical aspect of product efficacy.

The GF-120 NF bait was first shown to be an option as a cherry fruit fly control material and method in 2002 and 2003 through this project. See table 2 for the summary of all test results 2002-2005. As application of an insecticidal bait is a new practice to Pacific Northwest tree fruit producers, research and educational efforts were closely linked. Numerous presentations and publications gave the cherry growers opportunity to become aware of this material and its potential. ***Use in the first two years of registration has saved Washington cherry growers about \$1,160,000*** in labor, machinery and material costs, and economic benefits will continue at about \$1 million per season at current use levels. Adoption of this new technology has essentially eliminated a serious, and increasing problem with cherry fruit fly in

organic orchards. It has also enhanced the conventional growers' ability to treat orchards in a timely manner, despite wind. Use of the product increased by 360 percent in 2005 vs 2004, and acceptance of this technology is expected to increase as the more skeptical growers gain confidence in its efficacy. Applicator exposure to products with potential to inhibit cholinesterase was reduced by about 6,600 hours during May, June and July of 2005. See table 3 for an organic material control results summary.

**Table 1. Details of Recent Trials of Organic Products or Active Ingredients::**

<b>Treatment</b>	<b>Trees / Sites</b>	<b>Days Interval Spray</b>	<b>Flies / Trap</b>	<b>Fruit Sample Number</b>	<b>Larvae Found in Fruit</b>
<b>Conventional Standard: Provado 1.6F, 6 oz/A 1st. Treatment, Carbaryl 4 pints/A second, Provado 6 oz/A third treatment, Success 4 oz/A 4th treatment + GF-120 BAIT weekly during and after harvest.</b>	18 / 4	3 @ 10 4 @ 7	55	1000	0
			27	1000	0
			11	1000	0
			35	1000	0
<b>Untreated Check Trees in 2005</b>	5 / 5	na	265	1000	447
			565	1000	497
			87	1000	303
			238	1000	540
			150	250	339
<b>Entrust 80W 1.9 oz / A 2005 Trials</b>	5 / 5	10	3	1000	0
			5	1000	0
			55	1000	0
			26	1000	0
			34	1000	0
<b>azadirachtin, neem 2004 Summary</b>	12/6	7	55	2000	102
<b>spinosad (Success, Entrust) Various Rates 1997-2004</b>	52/13	7	15	10,900	0
<b>GF-120 Bait 20 oz./A 2005 Summary</b>	14/12	7	3**	12,000	0

Notes: \* One interval of 12 days between sprays may have caused this specific control difficulty.

\*\*There were trees treated 1, 2 and 3 seasons by 2005. Trees treated for the first time in 2005 had an average of over 50 adults per trap the previous season. The bait treatment suppressed trap catch on these trees to 7 in 2005. Only two of the five trees in their second year of treatment had any adults on the trap. By the third season, four adults were trapped on one site, the other three had zero.

**Table 2. Details of 2002-2005 Gf-120 Bait Trials:**

Site	Year	T Trees / site	Flies/ Trap Prior Year*	Flies/ Trap Treated Year	Total Fruit Inspected	Total Larvae Found
<b>Untreated Checks</b>	<b>na</b>	<b>12</b>	<b>&lt; 20</b>	<b>144</b>	<b>8065</b>	<b>2428</b>
<b>02-1</b>	<b>2002</b>	<b>4</b>	<b>50+</b>	<b>4</b>	<b>500</b>	<b>0</b>
<b>03-1</b>	<b>2003</b>	<b>1</b>	<b>14</b>	<b>25</b>	<b>400</b>	<b>0</b>
<b>03-1</b>	<b>2004</b>	<b>1</b>	<b>25</b>	<b>13</b>	<b>200</b>	<b>0</b>
<b>03-1</b>	<b>2005</b>	<b>1</b>	<b>13</b>	<b>0</b>	<b>1000</b>	<b>0</b>
<b>03-2</b>	<b>2003</b>	<b>1</b>	<b>25</b>	<b>15</b>	<b>400</b>	<b>0</b>
<b>03-2</b>	<b>2004</b>	<b>1</b>	<b>15</b>	<b>65</b>	<b>200</b>	<b>0</b>
<b>03-2</b>	<b>2005</b>	<b>1</b>	<b>65</b>	<b>4</b>	<b>1000</b>	<b>0</b>
<b>03-3</b>	<b>2003</b>	<b>1</b>	<b>100</b>	<b>13</b>	<b>400</b>	<b>0</b>
<b>03-3</b>	<b>2004</b>	<b>1</b>	<b>13</b>	<b>6</b>	<b>200</b>	<b>0</b>
<b>03-4</b>	<b>2003</b>	<b>1</b>	<b>15</b>	<b>0</b>	<b>400</b>	<b>0</b>
<b>03-4</b>	<b>2004</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>200</b>	<b>0</b>
<b>03-4</b>	<b>2005</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1000</b>	<b>0</b>
<b>03-5</b>	<b>2003</b>	<b>1</b>	<b>50</b>	<b>0</b>	<b>200</b>	<b>0</b>
<b>03-5</b>	<b>2004</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>200</b>	<b>0</b>
<b>03-5</b>	<b>2005</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1000</b>	<b>0</b>
<b>03-6</b>	<b>2003</b>	<b>12</b>	<b>90</b>	<b>25</b>	<b>700</b>	<b>1*</b>
<b>04-2</b>	<b>2004</b>	<b>1</b>	<b>22</b>	<b>2</b>	<b>250</b>	<b>0</b>
<b>04-3</b>	<b>2004</b>	<b>1</b>	<b>?</b>	<b>4</b>	<b>200</b>	<b>0</b>
<b>04-4</b>	<b>2004</b>	<b>2</b>	<b>?</b>	<b>8</b>	<b>200</b>	<b>0</b>
<b>04-5</b>	<b>2004</b>	<b>2</b>	<b>40</b>	<b>8</b>	<b>250</b>	<b>0</b>
<b>04-6</b>	<b>2004</b>	<b>1</b>	<b>50+</b>	<b>19</b>	<b>200</b>	<b>0</b>
<b>04-7</b>	<b>2004</b>	<b>4</b>	<b>50+</b>	<b>15</b>	<b>250</b>	<b>0</b>
<b>04-8</b>	<b>2004</b>	<b>1</b>	<b>50+</b>	<b>28</b>	<b>500</b>	<b>0</b>
<b>04-8</b>	<b>2005</b>	<b>1</b>	<b>28</b>	<b>5</b>	<b>1000</b>	<b>0</b>
<b>04-9</b>	<b>2004</b>	<b>3</b>	<b>50+**</b>	<b>205</b>	<b>250</b>	<b>1*</b>
<b>04-9</b>	<b>2005</b>	<b>3</b>	<b>205</b>	<b>2</b>	<b>1000</b>	<b>0</b>
<b>04-10</b>	<b>2004</b>	<b>1</b>	<b>?</b>	<b>4</b>	<b>250</b>	<b>0</b>
<b>04-10</b>	<b>2005</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>1000</b>	<b>0</b>
<b>04-11</b>	<b>2004</b>	<b>1</b>	<b>50+</b>	<b>34</b>	<b>200</b>	<b>0</b>
<b>04-11</b>	<b>2005</b>	<b>1</b>	<b>34</b>	<b>0</b>	<b>1000</b>	<b>0</b>

<b>04-12</b>	<b>2004</b>	<b>2</b>	<b>50+</b>	<b>24</b>	<b>200</b>	<b>0</b>
<b>04-12</b>	<b>2005</b>	<b>2</b>	<b>24</b>	<b>0</b>	<b>1000</b>	<b>0</b>
<b>05-1 new</b>	<b>2005</b>	<b>1</b>	<b>20</b>	<b>3</b>	<b>1000</b>	<b>0</b>
<b>05-2 new</b>	<b>2005</b>	<b>1</b>	<b>13</b>	<b>1</b>	<b>1000</b>	<b>0</b>
<b>05-3 new</b>	<b>2005</b>	<b>1</b>	<b>50+</b>	<b>18</b>	<b>1000</b>	<b>0</b>
<b>Totals:</b>		<b>35 site- years</b>			<b>18,750</b>	<b>2*</b>

\*"Failures" likely due to extreme infestations and large trees, first year of treatment.

\*\* Fruit was 100% infested on these three large trees year prior to first treatment.

### **Discussion:**

All products, rates and timings were tested under pest population conditions far in excess of what would be expected in commercial orchards. As adults emerge daily during the season, spraying significantly reduces, but does not eliminate adult trap catch on infested trees. The number of adults caught during the treatment year is an indicator of the amount of "pressure" the test tree is experiencing. If high numbers of adults are trapped during the first season of treatment, either the product is not an effective adulticide, or there were very high numbers of adults emerging from the previous season's infestation. However, effective control products protect the fruit from larval infestation by controlling adults prior to their maturation and egg deposition.

Under the severe test conditions, GF-120 bait treatment "failed" twice out of the 35 site treatment years. The fact that a two larvae were found out of 18,750 cherries crushed from these 35 treatment sites should be considered incidental results of a successful research effort, rather than an indication that the product will not be effective when used as directed under normal pest pressure situations. In both cases that larvae were found, the treatment sites can only be described as abnormal. The treatment trees were very tall, interwoven, and the fruit was infested at 50 - 100% the year prior to first treatment. In one case, the trees were removed after the first season, but the other, site 04-9, provides a great case study. On this "failure site," the three infested trees are 45-55 feet tall, and 100% of the fruit was infested and unharvested in 2003. Evaluation of 2003 trap catch by the local pest board was suspended after over 50 adults were captured the first week of trap deployment. During 2004, the first season of bait treatment, 205 adults were captured on a single trap, despite a 40 oz./A rate of GF-120, applied weekly. However, the larval infestation fell from the reported 100 percent to 0.25 percent (1 larva in 250 fruit). In 2005, the second season of treatment, the trees were treated at the 20 oz./A rate weekly. Adult capture fell from 205 to 2 for the season, and no larvae were found in a 1000 fruit sample.

Based on 100% fruit infestation in 2003, it is likely that about 4000 - 5000 adult flies emerged from the soil under each treated tree on site 04-9 in 2004. The fruit infestation level was dropped to 0.25 percent in 2004, which would lead to a calculated emergence of about 100 adults/tree in 2005. This level of infestation appeared susceptible to GF-120.

In 2005 no larvae were found in 12,000 fruit sampled from twelve bait-treated sites. The only control product applied to these previously highly infested sites was GF-120 bait. Similar untreated check trees developed larva counts ranging from 30 to 136 percent.

