# 2005 Western Cherry Fruit Fly Control Trial
# "Evaluation of Dow GF-120 NF and Fruit Fly Bait Concentration"
# Kaysville Research Farm, UT

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**Questions Posed:**
1. How effective is GF-120 NF in preventing fruit injury in a tart cherry orchard with a high population of western cherry fruit fly (WCFF) (>50 adults/trap/week in untreated plots from mid June to mid July)?
2. How does fruit fly bait concentration (20% and 40%) influence adult attraction and retention (i.e., trap catch) and efficacy of GF-120?
3. Are adults attracted to non-host trees (peaches and pears) treated with fruit fly bait (at 20% or 40% concentration)?

**Methods:**

***Experimental Design***
Plot design included insecticide treatment (GF-120 NF, Guthion, and untreated control) as a whole-plot factor and fruit fly bait concentration (20% and 40% in GF-120 NF and untreated plots only) as a split-plot factor. The Guthion plot was not treated with bait, but left as an insecticide buffer between untreated and GF-120 plots. The reason was to avoid interference of WCFF adults in orienting to the two bait concentrations in the untreated and GF-120 plots. Insecticide treatments were applied to 0.7 acre plots (plot size = 9 rows × 14 trees; tree spacing = 12 ft × 20 ft) in a 2.1 acre 'Montmorency' tart cherry orchard on the Utah State University Agricultural Experiment Station Farm in Kaysville, UT (see plot map). Within each insecticide plot (one replication each), the two fruit fly bait concentrations (20% and 40%) were randomly assigned to each half-plot, except no fruit fly bait was applied to the Guthion plot. Insecticide × bait concentration treatments were replicated four times (Replicates A-D; except the Guthion-no bait plot had 8 replicates, A-H), and were two rows wide by seven trees long (see plot map).

In addition to insecticide × bait concentration plots in the tart cherry orchard, 20% and 40% blank fruit fly bait were applied to two adjacent sections of non-host orchards (pear and peach, respectively) to determine if WCFF could be attracted away from cherry and into non-host trees for destruction. Non-host plots were three rows (peach) and four rows (pear) wide by 14 trees in length (12 ft ×20 ft spacing) (see plot map).

***Adult Trapping***
Forty-eight AM yellow sticky traps with additional ammonium carbonate bait were placed in the study orchard on May 19 before the first emergence of WCFF adults was predicted with a degree-day model. Two traps were placed in each insecticide × bait plot and oriented on the eastern or western edge so that trap catch densities could be compared between the borders and interior of the plots. Fourteen additional WCFF traps (same as above) were placed in the non-host plots with 2 traps in each row (8 traps in pear and 6 traps in peach) (see plot map). The first catch of WCFF adults occurred on May 23. WCFF adults were counted and removed from traps every 1-2 weeks through Aug 24. Traps were replaced and ammonium carbonate bait boxes were refilled as needed.

***Treatments and Applications***
The first application of treatments was made on Jun 3, 11 days after emergence of the first adults.

*Insecticide × bait concentration treatments (see plot map):*

1. UC20: Untreated control + 20% blank fruit fly bait (1:4 dilution in water)
2. UC40: Untreated control + 40% blank fruit fly bait (1:1.5 dilution in water)
3. GU: Guthion 50WP @ 1.5 lb/acre without fruit fly bait
4. GF20: GF-120 NF @ 20 fl oz/acre (diluted 1:4 with water) – contains 20% fruit fly bait
5. GF40: GF-120 NF @ 20 fl oz/acre (diluted 1:4 with water) + additional blank fruit fly bait to equal 40% total fruit fly bait
6. NF20: Non-host pear plot treated with 20% blank fruit fly bait (1:4 dilution)
7. NF40: Non-host peach plot treated with 40% blank fruit fly bait (1:1.5 dilution)

Guthion was applied to every row of the GU plot with an orchard air blast sprayer at 70 gal of dilute spray per acre. GF-120 and blank fruit fly bait were applied to every row of the respective plots with a handgun sprayer (D3 nozzle; 15 gal tank with 45 psi electric pump) mounted on a 4-wheeler driven at 6 mph. Application dates for Guthion were Jun 3, 13, and 27 (3 applications). GF-120 and blank bait treatments were applied on Jun 3,

8, 13, 20, and 24, and Jul 1 and 8 (7 applications). Planned reapplication intervals were 14 days for Guthion and 7 days for GF-120 and blank bait, but due to rain events, several reapplication intervals were shortened. Although the Guthion label prevents more than two applications to cherry per season (no more than 3 lb Guthion per acre allowed per season), we went off-label for the research trial because we wanted to avoid more frequent application of a shorter-protection insecticide following rain storms. The fruit were not harvested for sale or consumption.

***Fruit Injury Sampling***

To assess fruit infestation, once per week beginning on Jun 9 (when fruit began turning color from green to yellow) 100 fruit were collected from the six center trees of each insecticide × bait plot and placed on wire mesh above plastic trays to collect last-instar larvae as they emerged. When fruit were mature on Jul 13, two final types of samples were collected: 1) 500 fruit per plot were placed on emergence trays and 2) 100 fruit per plot were individually inspected for exit holes and cut open to count the number of 1st, 2nd, and 3rd instar larvae inside.

***Data Analyses***

Cumulative adult trap catch and fruit infestation data were compared among all insecticide × bait concentration treatments with analysis of variance (Proc GLM; SAS version 9.0, 2002). In addition, a factorial analysis (with insecticide as main effect and bait as split-plot effect) was conducted on GF and UC treatments. Influence of trap and fruit sample location within plots (near or far from other treatments and outside borders) on adult catch and fruit infestation, respectively, were compared within each treatment. And finally, adult catch in non-host pear and peach plots was compared across the three or four rows to evaluate the influence of distance from cherry on attractiveness of the bait to adults. When treatment means were different in analyses of variance, they were separated with the Waller-Duncan *k*-ratio *t*-test.

**Results:**

***Attraction and Retention of Adults***

Adult trap catch peaked in late June to early July and then declined in late July and August (Fig. 1). There was a small increase in trap catch on Aug 24 in most treatments (Fig. 1). Cumulative adult catch (May 23-Aug 24) was significantly greater in untreated control plots than in all others ($F = 59.1$, $p < 0.0001$) (Fig. 2). Cumulative adult catch was numerically greater in Guthion plots than in GF and NH plots, but not significantly. Comparing bait concentration within GF and UC plots, significantly more adults were caught on traps in plots treated with 40% than 20% bait ($F = 7.0$, $p = 0.01$).

**Fig. 1.** Influence of insecticide treatments on adult trap catch over time. GF=GF-120, GU=Guthion, NH=Non-host, UC=Untreated Control; 20=20% bait and 40=40% bait.

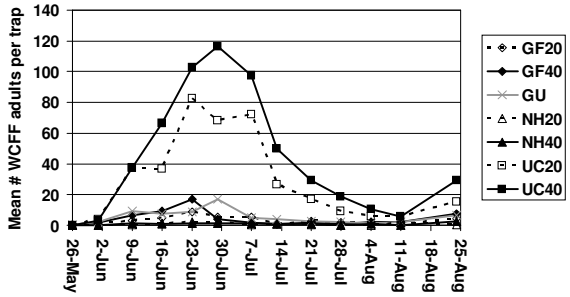



**Fig. 2.** Mean cumulative number of adults per trap (May 23 – Aug 24) as influenced by insecticide treatment. GF=GF-120, GU=Guthion, NH=Non-host, UC=Untreated Control; 20=20% bait and 40=40% bait.

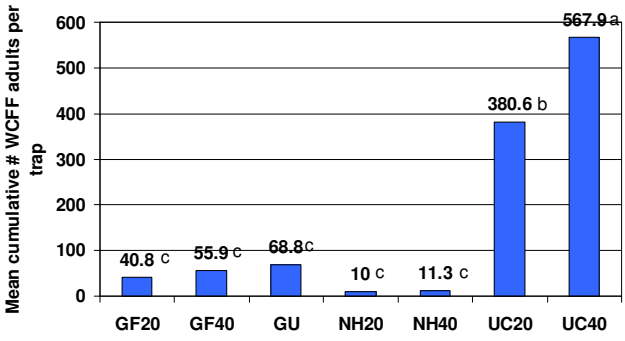
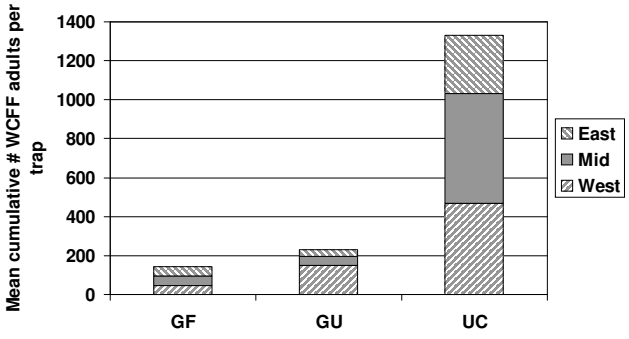



**Fig. 3.** Influence of trap location within plot on mean cumulative number of adults per trap. GF=GF-120, GU=Guthion, and UC=Untreated Control.




Trap location influenced cumulative adult catch in GU and UC plots, but not in GF plots (Fig. 3). In GF plots, similar numbers of adults were caught on the outside border (East) as in the middle (Mid) and on the border next to GU plots (West). In GU plots, more adults were caught on the border next to UC plots (West) than in the middle or next to GF plots (East) ($F = 43.0$, $p < 0.0001$).

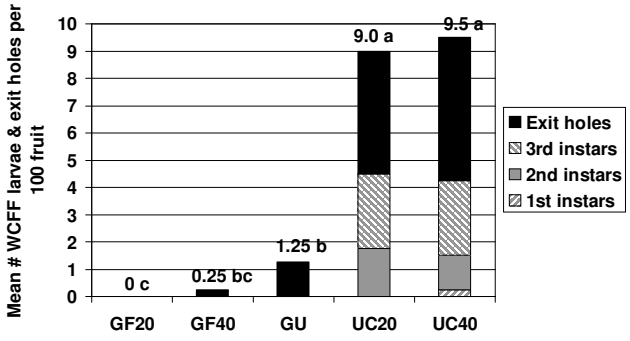
And in UC plots, more adults were caught on traps in the middle (Mid) than next to the border with GU plots (East) (F = 4.6, $p$ = 0.03) (Fig. 3).

Although a low number of adults were attracted onto traps in the two non-host plots, cumulative counts didn't vary with bait concentration or distance from the tart cherry orchard (6.5-13.5 adults per trap across rows of both pear and peach NH plots).

***Fruit Injury***

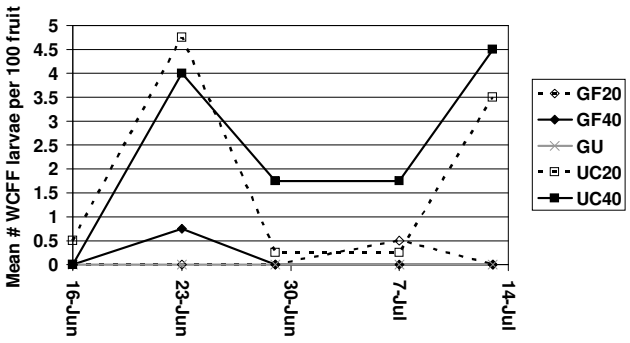
Total number of larvae and exit holes in mature cherry fruits collected on Jul 13 and dissected to determine infestation were significantly greater in untreated control treatments (UC20 and UC40) than in all others (F=23.74, $p$<0.0001) (Fig. 4). There was a low level of injury in the GU (1.25 exit holes per 100 fruit) and GF40 treatments (0.25 exit holes per 100 fruit), but none in GF20. The main WCFF life stages and injury present were 2nd and 3rd instars and exit holes (Fig. 4). Although cutting open fruit to count larvae present at the moment excluded inclusion of eggs in the injury assessment, as there were so few 1st instar larvae present in the harvest sample, the density of unhatched eggs was likely very small. Therefore, fruit dissection at harvest provided an accurate measurement of WCFF injury to mature fruits.

**Fig. 4.** Influence of insecticide treatments on cherry fruit injury at harvest (Jul 13). GF=GF-120, GU=Guthion, and UC=Untreated Control; 20=20% bait and 40=40% bait.



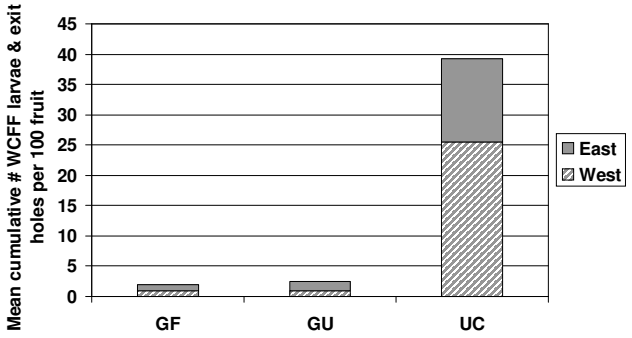

Fruit that were collected each week and placed on emergence trays allowed eggs and young larvae to complete development for inclusion in the injury assessment. Infested fruit were first found on Jun 16 when about half of the fruit were still green and the other half were yellow or rosy in color. Mean larval emergence from fruit from Jun 16 to Jul 13 was less than one per 100 fruit except in untreated control plots where emergence peaked on Jun 23 (4.8 and 4.0 larvae per 100 fruit in UC20 and UC40 plots, respectively) and again on Jul 13 (3.5 and 4.5 larvae per 100 fruit in UC20 and UC40, respectively) (Fig. 5). Comparisons of larval emergence among treatments by sample date showed that significant differences occurred on every date: Jun 16 (F=4.0, $p$=0.02; UC20>all others), Jun 23 (F=6.1, $p$=0.002; UC20 and UC40>all others), Jun 29 (F=6.6, $p$=0.002; UC40>all others), Jul 7 (F=3.8, $p$=0.02; UC40>all others), and Jul 13 (F=5.5, $p$=0.004; UC40 and UC20>all others). A few WCFF larvae emerged from fruit in GF treatments (0.75 larvae per 100 fruit in GF40 on Jun 23 and 0.5 larvae per 100 fruit in GF20 on Jul 7), but none emerged from the GU treatment (Fig. 5).

**Fig. 5.** Emergence of WCFF larvae from cherry fruits from mid June to mid July as influenced by insecticides and bait concentrations. GF=GF-120, GU=Guthion, UC=Untreated Control; 20=20% bait and 40=40% bait.




Location of trees within GF, GU, and UC plots did not influence fruit infestation when cumulative numbers of larvae and exit holes from Jun 16 to Jul 13 (data from emergence trays and dissected fruits combined) were compared (Fig. 6). Fruit infestation was low in GF plots and was similar between the outside border (East) and the border with GU plots (West). Fruit infestation was also low in GU plots and was similar between the border with GF (East) and UC plots (West). Fruit injury was higher in UC plots, and numerically higher on the outside border (West) than the border with GU plots (East), but not significantly different (Fig. 6).

**Fig. 6.** Influence of plot location on cumulative WCFF infestation per 100 fruit. GF=GF-120, GU=Guthion, and UC=Untreated Control.



**Conclusions:**

Fruit fly bait concentration influenced WCFF adult attraction and retention in plots: more adults were caught on traps in GF-120 and untreated control plots sprayed with 40% than 20% bait. In contrast, bait concentration did not influence larval infestation of fruits. The objective was to determine if in an orchard with a high density of WCFF, spraying 40% bait would attract and kill adults more effectively than 20% bait, thus enhancing the efficacy of the GF-120 insecticide. Although more adults were caught on traps in 40% bait plots, the lack of difference in fruit injury between 20% and 40% bait plots treated with GF-120 does not support the use of the higher bait concentration.

All plots treated with GF-120 and Guthion had very low fruit injury, and it was significantly less than injury in untreated control plots. A total of two, four, and 10 larvae and exit holes were found in cherries in GF20, GF40, and Guthion plots, respectively for all fruits placed on emergence trays and dissected at harvest (out of 4,000, 4,000, and 8,000 total fruits for GF20, GF40, and GU treatments, respectively). In comparison, a total of 73 and 86 larvae and exit holes were found in untreated control plots treated with 20% and 40% fruit fly bait, respectively (out of 4,000 total fruits each). In untreated plots, fruit infestation was numerically, but not significantly higher in the higher bait concentration treatment.

Fruit injury in GF-120 and Guthion plots was likely higher than expected in typical commercial orchards because of the close proximity of untreated plots with high WCFF density. Guthion plots were especially challenged by a large population of WCFF because they were placed in the middle of the 2.1 acre orchard between GF-120 and untreated control plots. This effect was seen in the higher numbers of WCFF adults caught in Guthion plots on the border shared with untreated control plots than in the middle or on the border shared with GF-120 plots.

Non-host trees treated with 20% and 40% fruit fly bait attracted only a low number of WCFF adults, and trap catch was not influenced by bait concentration. Use of a non-host orchard treated with fruit fly bait as a trap crop does not appear to be an effective management strategy for WCFF.