AGRICULTURAL RESEARCH FOUNDATION
FINAL REPORT
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TITLE: Testing an oviposition deterrent for Spotted-wing drosophila in cherry orchards.

RESEARCH LEADER:

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EXECUTIVE SUMMARY:

As the quest for creating environmentally-friendly ways to control *Drosophila suzukii* (SWD) infestations in cherries continues, we here tested a food-grade product (gum) developed by our co-investigators. In preliminary laboratory trials, this gum substrate was shown to be very attractive to female SWD. When presented in choice experiments with other fruit, female SWD preferred to oviposit in the gum substrate, and consequently reduced the number of eggs laid in multiple fruit. The effect of this gum in cherries at a field scale had not yet been tested.

We tested liquid gum in bagged cherry clusters in tree branches in the field, and whole-tree enclosures. When SWD were bagged in cherry clusters with 5 mL of gum, there was a tendency to have fewer infested cherries, and fewer SWD larvae. The number of infested cherries enclosed with liquid gum was reduced by 33-44%, compared to untreated control (with no gum). Likewise, the total number of SWD larvae extracted from cherry clusters enclosed with liquid gum was reduced by 40-58%.

In whole tree enclosures, we did not find an effect of exposure to gum on SWD infestations. Cherries collected from trees with gum had a similar number or SWD larvae compared to trees with no gum. SWD infestation was higher in the bottom and middle canopy, compared to the top canopy. In whole-tree enclosures, we applied 100mL of gum, and it is possible that this amount is not enough to attract SWD females to oviposit. Future studies

should focus on testing variable amounts of gum in whole trees, refining optimal application rates, identifying the best locations to apply within the canopy, and making use of irrigation systems to keep gum moist.

In addition to oviposition deterrent field trials, we also tested solid gum as a potential oviposition monitoring tool in the field. We placed exposed petri dishes with solid gum and a commercial SWD lure on the edges of an unsprayed cherry orchard during the early season. Every week, we retrieved the gum and inspected it for the presence of SWD eggs. We did not find any eggs in the gum, but it is possible that we only monitored during a short period during the early season, when overall SWD populations are low in the field. Future studies should explore whether these gum lures can be used to monitor field oviposition throughout the cherry growing season.

OBJECTIVES:

1. To test the oviposition deterrent effects of a solid and liquid gum matrix for *Drosophila suzukii* (SWD) in cherry trees.
2. To test the potential for solid gum baits as efficient monitoring tools for *Drosophila suzukii* (SWD) oviposition.

PROCEDURES:

Oviposition deterrence

We tested liquid gum baits in cherry branch enclosures and whole tree enclosures in a young unsprayed cherry block (cv. Lapin) on 25 Jun 2018, and 5 Jul 2018.

For branch enclosures, we selected one cluster of 10-15 cherries in each tree, and covered it with a mesh bag. Ten clusters were treated with gum, and 10 clusters served as an untreated control with flies. Five mature males and five mature females were released inside each mesh bag between 6pm and 8pm inside each mesh bag. Flies were provided with a foam plug soaked in sugar water as a food source (Fig. 1). We placed a cloth rectangle with 5mL of liquid gum inside 10 treated mesh bags. As a laboratory control, we placed 10 cherries, 5 males, 5 females, and a cotton ball with sugar water inside a pint vented container, where flies could freely oviposit. After 72 h, we collected the cherries and incubated them for further 3 days in laboratory conditions. After this period, we extracted larvae from each cherry using a salt flotation method (Figs. 2, 3), and we counted 1) number of cherries with (any) larvae in each branch cluster, and 2) total number of larvae extracted from each branch cluster.

Figure 1. Cherry branch enclosures to test gum.

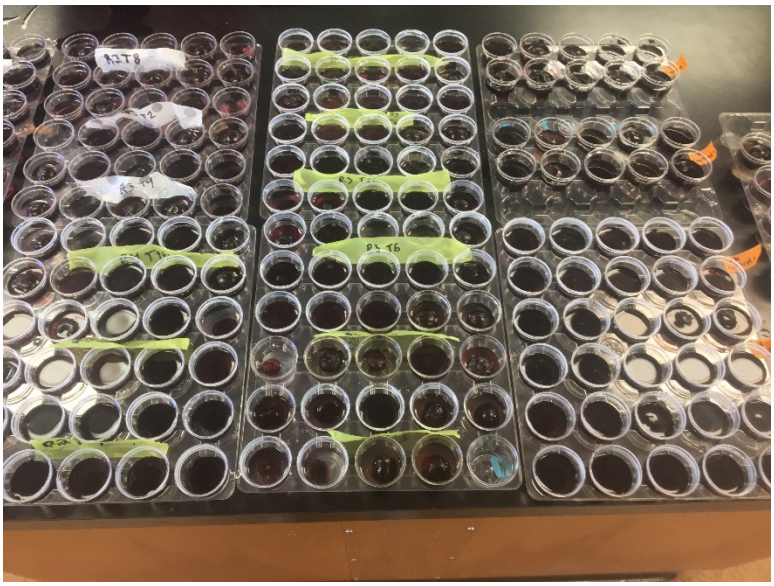

Figure 2. Salt flotation method to extract SWD larvae from individual cherries.

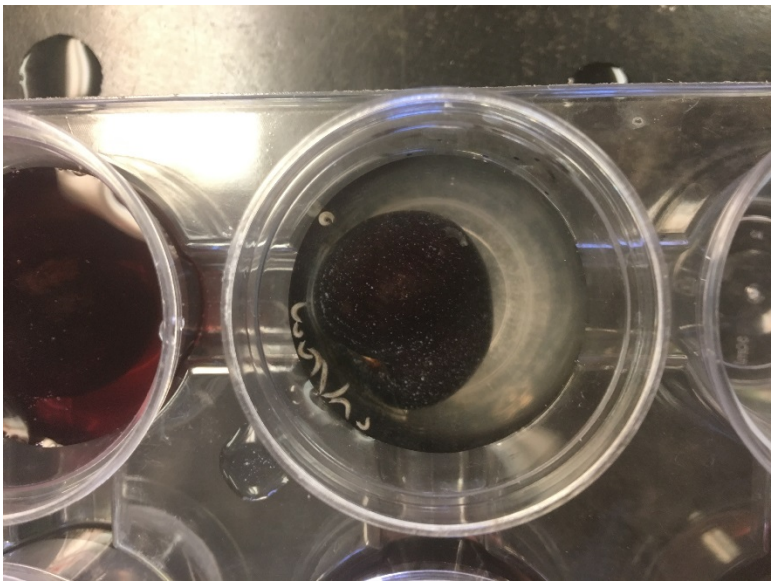

Figure 3. SWD larvae extracted from a single cherry.

For whole-tree enclosures, we covered 20 trees with a mesh cage (6ft x 6ft x10ft; Fig. 4). Inside each cage, 50 mature males and 50 mature females were released between 6pm and 8pm. 10 gum-treated trees had a cloth rectangle soaked in 100mL of liquid gum attached to a tree branch in the middle of the canopy (Fig. 5), and 10 untreated trees did not have any gum. After 72 h, we collected 20 cherries from the top of the canopy, 20 from the middle, and 20 from the bottom. Cherries were incubated for 3 more days in laboratory conditions. After this period, SWD larvae were extracted from the cherries using a salt flotation method.

Figure 4. Whole tree enclosures to test liquid gum.

Figure 5. Cloth rectangle soaked in 100mL of liquid gum, and attached to a branch in the middle of the tree canopy.

Monitoring

We tested solid gum as a monitoring tool for early oviposition in cherry orchards. An oviposition monitoring station consisted of 100mL of solid gum bait deposited in a petri dish, and placed on a tree branch underneath a commercial SWD Scentry lure. We placed two monitoring stations on the edges of a 0.3 acre cherry block (cv. Lapin) during May 2018. Due to the limited availability of gum, this experiment could not be replicated in other orchards, or tested for a longer period. Each week, the gum bait was replaced with fresh gum. Each gum bait was inspected under the microscope for the presence of SWD eggs. We additionally collected 10 cherries from 18 trees every week, and tested for SWD infestation using the salt flotation method described above.

SIGNIFICANT ACCOMPLISHMENTS:

Oviposition deterrence

There was a tendency for gum-treated clusters to have fewer infested cherries compared to untreated clusters (df = 1, 43, F = 12.67, p < 0.01; difference between gum-treated and untreated clusters p = 0.055). On the first date tested, there was on average a 33% reduction on number of infested cherries, on the second date tested, there was a 44% reduction on number of infested cherries (Fig. 6).

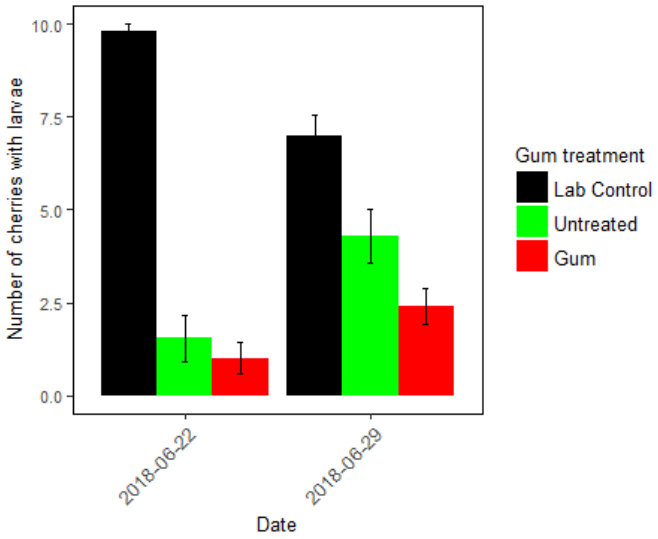

Figure 6. Number of infested cherries (mean ± SE) in each cluster treated and untreated with gum.

There was a non-significant tendency for gum-treated clusters to have fewer total larvae compared to untreated clusters (df = 1, 43, F = 10.16, p < 0.01; difference between gum-treated and untreated clusters p = 0.065). On the first date tested, there was on average a 40% reduction on number of total larvae, on the second date tested, there was a 58% reduction on number of total larvae (Fig. 7).

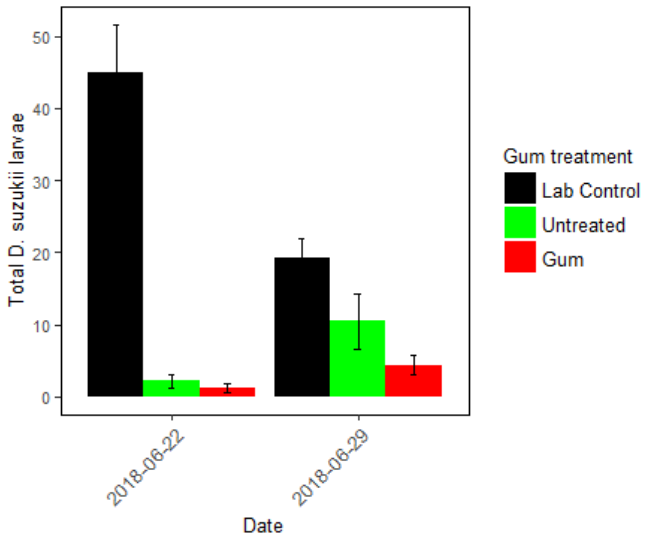

Figure 7. Number of extracted SWD (mean ± SE) in each cluster treated and untreated with gum.

There was no effect of gum treatment in the total number of larvae extracted from the cherries ($df = 1, 93$, $F = 0.05$, $p = 0.81$). There was a location effect, and fewer larvae were extracted from the top of the canopy compared to the middle and bottom ($df = 2, 93$, $F = 22.08$, $p < 0.01$; Fig. 8).

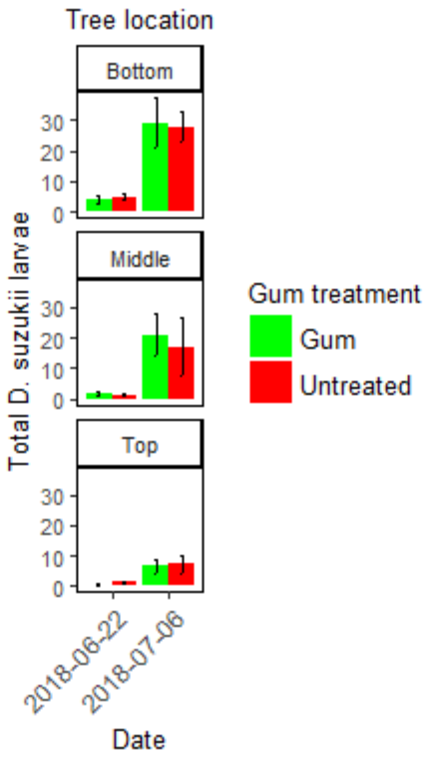

Figure 8. Total SWD larvae extracted from 20 cherries in the top, middle and bottom canopy in trees treated and untreated with liquid gum.

In general, these results showed that in small scales gum can be effective in reducing the number of cherries infested, and total number of larvae. But when applied in large scale to a whole tree, gum was not effective in reducing infestation. This could be due to the total volume of gum applied necessary to be effective; in this study we applied 100 mL of gum in each whole-tree enclosure, and it is possible that a larger amount is required. The fact that more larvae were collected from the middle and bottom canopy suggests that, with a limited quantity of product available, application efforts should be focused in this area. Another issue was that after 3 days of application, the gum was already dry and powdery, and possibly less attractive to SWD females. Other ongoing trials are currently exploring ways to maintain gum moisture (for example, by utilizing existing irrigation systems). This gum formulation continues to be tested and improved, and more field trials are need to determine its effectiveness.

Monitoring

During the oviposition monitoring period, no SWD eggs were found in the gum bait, and none of the cherries collected from the trees were infested with SWD. These results are inconclusive, and could be due to many factors: 1) SWD females were not attracted to the gum baits to oviposit, or 2) the SWD population in this orchard during the trialed period was too low to detect any oviposition. Future trials should expand the monitoring period throughout the growing season.

BENEFITS & IMPACT:

The development of a food grade gum is an important step in improving our IPM toolbox for controlling SWD in cherries and small berries. Influencing oviposition behavior can lead to reduction of insecticide applications, and it can facilitate production of organic crops. We are continuing to improve the formulation and delivery of this product, by testing new compounds, adjusting the adequate application rate, and looking for ways to extend its efficacy in the field.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:
Washington Tree Fruit Research Commission, $10,000

FUTURE FUNDING POSSIBILITIES**:**

Follow-up projects can be funded by the Washington Tree Fruit Research Commission, the Northwest Center for Small Fruit Research commission, and the USDA Organic Agriculture Research and Extension Initiative.