

**AGRICULTURAL RESEARCH FOUNDATION  
FINAL REPORT  
FUNDING CYCLE 2018 – 2020**

**TITLE:**

**Two products to reduce spotted-wing drosophila egg laying in strawberry and caneberry.**

**RESEARCH LEADER:**

Dr. Vaughn Walton

**COOPERATORS:**

Dr. Marco Valerio Rossi-Stacconi

**EXECUTIVE SUMMARY:**

We showed under laboratory and field conditions the efficacy of both new technologies. We also demonstrated field longevity and range of a new field delivery device on blueberry of the arriant. The first technology is being considered by an international Pest Management company. The Food-grade gum is being commercialized by a spinout company during 2020.

**OBJECTIVES:**

The goal of this work is to reduce oviposition in strawberry, blackberry and raspberry. Both products were tested to determine if their use will result in reduced egg laying on strawberry, and caneberries under field conditions.

- 1. Laboratory trials to determine effectiveness of egg protectant product against *D. suzukii* on Strawberry, and Caneberry.**
- 2. Laboratory and field experiments to determine effectiveness of agar GUM as a reducer of *D. suzukii* egg laying on Strawberry and Caneberry.**

**PROCEDURES:**

*Drosophila suzukii* were reared from laboratory colonies and were regularly supplemented from the field in the Willamette Valley of Oregon. Flies were reared in a cage (Bugdorm-1, 24x24 cm) and provided with a water wick and an artificial corneal diet that served as both an oviposition medium and food source. Insects were maintained in the laboratory at 22°C, 65% RH and a photoperiod of 8:16 h (light: dark). All *D. suzukii* were ca. 8 days old and previously mated. These flies were used to expose fruit to insects in both laboratory and field experiments.

- 1. Laboratory trials to determine effectiveness of egg protectant product against *D. suzukii* on Strawberry, and Caneberry (to be conducted during February 2019)**

For the protectant product, the focus was to determine the potential of this product against softer fruit, i.e. Strawberry and Caneberry. The proprietary protectant was mixed at a 0.5% rate with water compounds at room temperature, and sprayed on store-bought fruit under controlled conditions using a Potter Spray Tower in order to ensure even coverage. The sprayed fruit was subsequently be exposed to *D. suzukii* efficacy trials within 1-2 days after application in laboratory experiments. These experiments will be conducted using 2 L Griffin-Style graduated, low-form transparent plastic beakers (Rochester, NY, U.S.A.). Containers were placed upside down on a

flat work surface covered by white paper sheets, allowing for easy introduction of test insects and compounds. Constant air ventilation were created within each of the containers using a vacuum system, preventing any fumigant effect by the test compound. The beakers were drilled with nine 1 cm diameter ventilation holes approximately 6 cm from the base of each container. These holes were covered with fine white mesh in order to serve as fresh air inlets and to prevent *D. suzukii* escape. The top of the containers were drilled with a similar-sized hole and connected with a 0.5 cm diameter plastic tubing providing a vacuum and constant and uniform air flow (1.5L/min) from the base and through the upper portion of each of the respective containers. No-choice experiments were conducted by presenting 5 to 10 fruit (Strawberry, Blackberry, Raspberry) in each of ten replicate samples in the laboratory experiments. Ten mated females and males each were placed within each arena for a 24 h period, allowing them to oviposit on fruit. The number of *D. suzukii* eggs laid per fruit was compared statistically using Tukey's HSD test after counting of eggs under the dissecting microscope.

## **2. Laboratory and field experiments to determine effectiveness of agar GUM as a reducer of *D. suzukii* egg laying on Strawberry and Caneberry**

The GUM attractant was mixed at a 1.5% rate with other proprietary food-grade compounds at room temperature. The resultant matrices will subsequently be used for *D. suzukii* efficacy trials within 1-2 hours after preparation in field experiments.

Laboratory experiments were performed on raspberries, strawberries, and blueberries under controlled conditions. Ventilated arenas were prepared as described for the double-choice experiments. Two 25-ml Deli cups (Dart Container Corporation, Mason, MI) were placed inside each arena, one containing ca.  $6 \pm 0.1$  g of matrix, and the other containing fresh fruit. For each fruit type, we exposed an approximate surface area of  $32 \text{ mm}^2$ , corresponding to the exposed area of the matrix within the Deli cup. Twenty *D. suzukii* individuals, ten females and five males, were released into each arena. After 24 h, the number of eggs laid in each Deli cup was counted. The treatments included an untreated control where arena's only had each of the respective fruit of approximate  $32 \pm 0.1 \text{ mm}^2$  surface area. The second treatment was gum matrix, which contained both the gum matrix and the fruit. The surface area of both the fruit and gum matrix exposed to air combined had a  $65 \pm 0.1 \text{ mm}^2$  surface area. The experiment for each of the fruit types was replicated ten times.

During both 2018 and 2019, all field trials were conducted at the Lewis Brown Farm at Oregon State University ( $44^\circ 33' 13'' \text{N}$   $123^\circ 13' 07'' \text{W}$ ). Strawberry *D. suzukii* exposure trials were conducted by covering plants within 12X5 ft mesh enclosures. Two hundred flies (100 male and female each) were released into the containers. Experiments for these trials were replicated 5 times. For raspberry, plants were spaced approximately 0.76 m apart within rows and 3.05 m between rows. The width and height of plants were approximately 1m and 1.5 m respectively. Two drip irrigation lines, one on either side of the raspberry plant, were placed under sawdust mulch cover within standard raised beds. We covered fruit clusters (10-23 berries) with 20 cm  $\times$  30 cm white organza mesh bags (Uline, Pleasant Prairie, WI). All mesh bags were placed approximately 1m apart on the north side of the bush within the shade of the canopy and 0.2 to 1.3 m above ground level. Each mesh bag contained ten *D. suzukii* adults, five females and five males. Solid gum matrices were added to the treatment net bags. Solid gum matrix was trialed using  $40 \pm 0.5 \text{ mL}$  contained

within 10-cm diameter petri dishes. Experiments containing these treatments were replicated ten times. Additional trials were carried out on blueberries to assess the longevity of the GUM attractant under field conditions. Blueberry plants were enclosed in net cages (13x6x5 ft) and exposed to an artificial infestation of *D. suzukii* as previously described for strawberry. Five treated and five control cages were set. The total exposure period was 21 days. Fruit samples were collected every 3 days from both treated and control cages (300 berries/cage/sampling date). In all experiments, fruit infestation was assessed in the laboratory observing the sampled berries under a stereomicroscope within 24h from the collection.

## SIGNIFICANT ACCOMPLISHMENTS:

**Objective 1.** The protectant did not affect egg laying levels of *D. suzukii* under the laboratory conditions. Both treated and untreated fruit had similar egg laying levels. This may have been attributable to low penetration force found because of the softness of the fruit.

**Objective 2.** Laboratory trials resulted in consistent reductions of egg laying. Results from the laboratory were similar under field conditions. These data suggest that, ultimately, this technology will be useful in blueberry, raspberry, blackberry, cherry, winegrape and strawberry production systems (Figure 1).

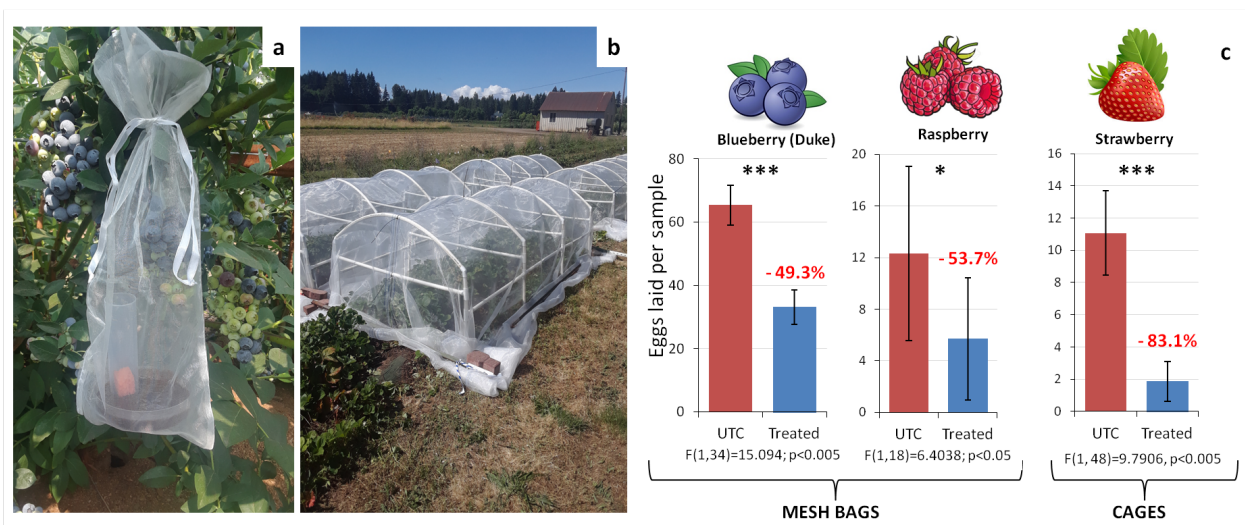


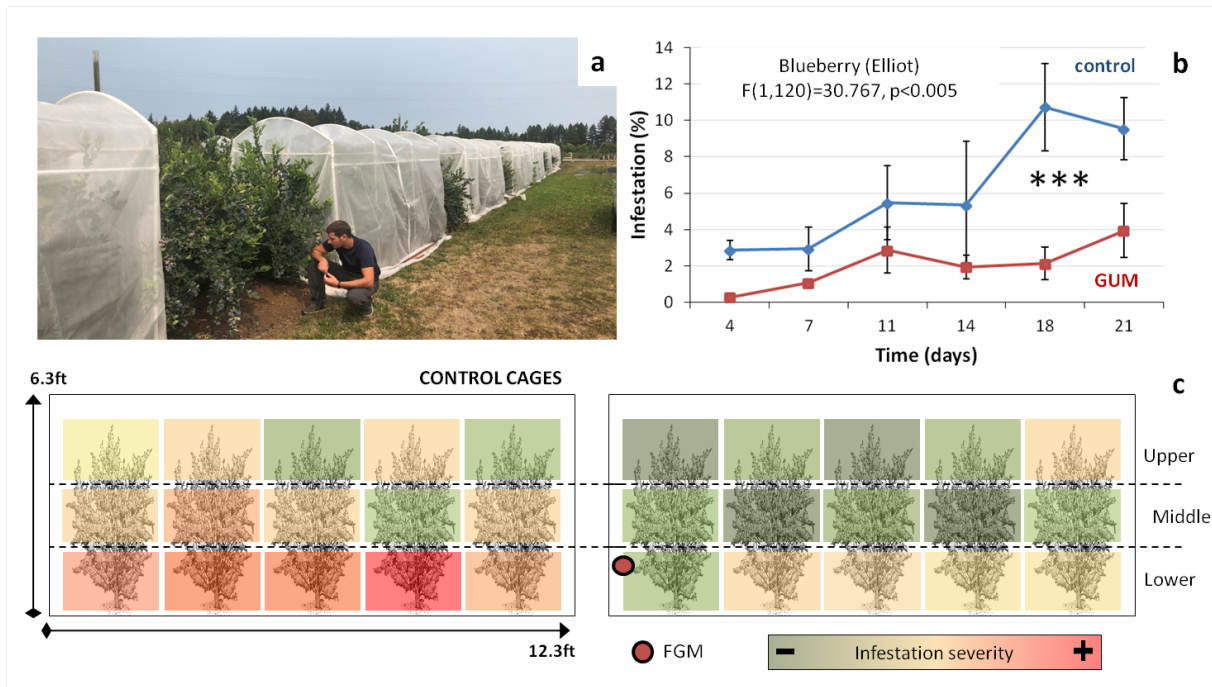
Figure 1: **Efficacy of the GUM attractant.** (a) Organza mesh bags and (b) cages used for the exposure field trials. (c) Infestation reductions achieved on different crops.

Additionally, we demonstrated that the use of our technology provides similar SWD control compared to conventional insecticides and up to 90% over periods of up to 21 days (Fig. 2).

The new field deployment delivery device was tested using point sources at 50 per acre resulted in crop protection at levels similar to insecticide in cherry during 2019 trials (Figure 3). We also demonstrated the active distance of these dispensers over a 21-day period in blueberry during 2019 (Figure 4). In 2019, we trialed a new application system using a hemp fiber (Fiber) substrate resulting in highly effective treatments that are similar to insecticides in efficacy both in caged and open-field trials. In open-field studies at the OSU-Lewis Brown experimental farm, fruit damage was reduced by an average of 67% over 21 days (Figure 4). These open-field trials

demonstrated an active range of these volatiles of 20-30 feet. This range will mean that growers can use such dispensers at the rate of ~50 dispensers/acre. While these data are promising, they were obtained without the use of any killing agent. We initiated trials using several food-grade and conventional killing agents. We demonstrated an additional improvement of efficacy under controlled conditions. We believe that inclusion of a killing agent will significantly improve results obtained under open field conditions as demonstrated during the 2019 season.

We believe these results indicate that this technique will improve production efficiencies and fruit quality, while reducing insecticide dependence.



**Fig.2. Longevity of the GUM attractant.** (a) Net cages used for the blueberry field trials. (b) Infestation reduction achieved over a 3-weeks period. (c) Schematic comparison of the average infestation within the canopy in control and treated cages. Color scale indicates the infestation severity. The placement of the Gum attractant within the treated cages is shown (red circle).

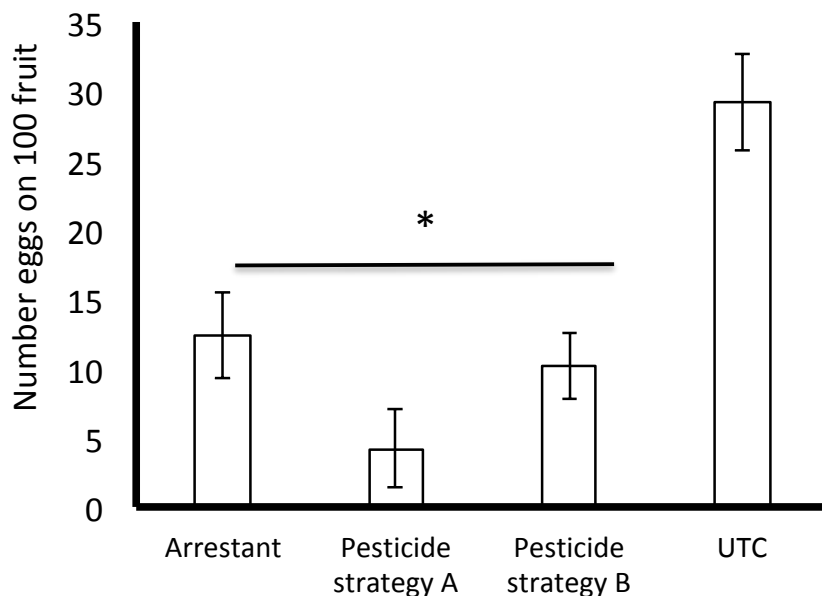


Figure 3. Comparison of arrestant to two pesticide strategies in cherry in Hood River during 2019. Experiments were conducted over three weeks, allowing six insecticide applications and one application of the arrestant.

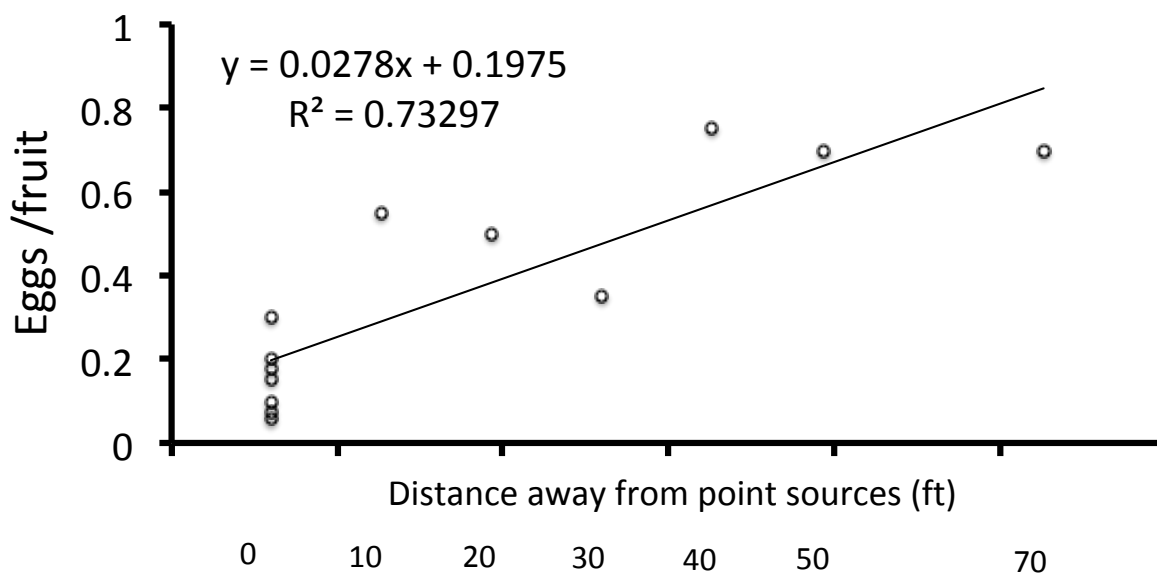


Figure 4. Open-field trials using arrestant point sources at the rate of 50 per acre on Elliot blueberry at the OSU Lewis-Brown farm during 2019 over a 21-day period.

These benefits will impact multiple facets of the affected industries, including key pollinator species such as European honeybees. Preliminary trials conducted in collaboration with the OSU apiculturist Dr. Ramesh Sagili have shown this non-toxic technology has no negative impact on honeybees and honeybee health.

#### **BENEFITS & IMPACT:**

The new technologies will reduce insecticide costs by a minimum of 50%, significantly improving economic competitiveness of farmers, agricultural workers and agricultural supply chain participants starting in Oregon. The reduction in toxic insecticide use will increase the sustainability, fruit quality and market access of fruits to the lucrative international export markets.

**ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:**

Dr. Vaughn Walton received a 2-year grant from the USDA OREI titled “Organic management of *Drosophila suzukii*”, the Oregon Blueberry and the Oregon Blackberry and Raspberry Commissions. We were successful obtaining funding from the Oregon University State Venture Development Fund (OUSVDF), which will expand understanding of the chemical composition of volatiles associated with this technology.

**FUTURE FUNDING POSSIBILITIES:**

Additional pending grant proposals include USDA AFRI, and USDA SCRI.