SPOTTED WING DROSOPHILA, A CONCERN FOR DRIED PLUM PRODUCERS?

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OBJECTIVE

1. Determine if fresh dried plums are a significant 'host' for spotted wing drosophila.

Of the approximately 3000 species of *Drosophila* commonly known as vinegar flies, *Drosophila suzukii* Matsumura (Diptera: Drosophilidae), known as cherry drosophila in Japan and now commonly called spotted wing drosophila (SWD) in the United States, is one of only two species known to oviposit in healthy (whole) fruit (Sasaki and Sato 1995), as opposed to fruit that is damaged or overripe. Two unique characteristics of *D. suzukii* make it a particularly onerous pest: its propensity for favoring ripening (as opposed to overripe) fruit (Mitsui 2006) and the prominent serrated ovipositor of the female, which upon insertion can cause physical damage to the host fruit. Very often oviposition wounds provide access to secondary infection by both insects and pathogens such as sour rots, causing additional losses. Eggs develop into larvae within the fruit, causing it to become soft and rot rapidly, resulting in reduced crop yields and significant financial losses.

The first detected North American mainland invasion of *D. suzukii* was in Santa Cruz County, California in August 2008, on strawberries and caneberries. In May 2009, economically damaging infestations were detected in cherry orchards in the Santa Clara Valley, and from Yolo to Stanislaus counties in California. Further trapping and identification efforts in the fall of 2009 confirmed *D. suzukii* presence over a wide geographic range, including the entire length of California's coastal counties, western Oregon, the Columbia River Gorge, counties throughout western Washington, and north into British Columbia. The first detection in Washington State occurred in strawberries at the Washington State University Puyallup Research and Extension Center on August 10, 2009; by the end of the year, *D. suzukii* had been positively identified in 10 Washington State counties. Oregon's first detection was made by a u-pick grower of blueberries in early August 2009; additional observations were confirmed in 16 Oregon counties and on 16 different fruits. It was also identified in Florida in August 2009 in rural Hillsborough County. Twenty-four Florida counties have subsequently confirmed the fly. In February 2010, *D. suzukii* was detected overwintering as adults on fallen citrus fruit near Bakersfield in California's San Joaquin Valley, subsequently attacking the very early cherry fruit grown nearby. In Fall, 2010, *D.suzukii* were detected in North and South Carolina, Michigan and Utah. A full description of its biology and implications of the North American invasion is presented by Walsh, et al. (2010). The potential economic implications of *D. suzukii* is presented in Bolda, et al. (2010).

Kanzawa (1939) observed that the fly oviposited most often on cherries, peaches, plums, persimmons, strawberries and grapes in Japan, but was also opportunistic and would feed on other fruits dropped on the ground that spoiled or fermented. In the absence of preferred fruit, he found *D. suzukii* would feed upon oak tree sap. *Drosophila suzukii* has now been documented in apricots, blackberries, blueberries, cherries, figs, grapes, hardy kiwis, nectarines, peaches, pears,

persimmons, plums, pluots, raspberries, and strawberries; it has additionally been observed feeding upon injured or culled fruit including apples and oranges Walsh et al. (2010).

PROCEDURES

Before the laboratory experiment began, on July 23, 2010, apple cider vinegar baited traps and bakers yeast, sugar and water baited traps were monitored at the mixed cherry and mixed plum blocks managed by USDA-ARS scientist Dr. Clay Weeks at the Wolfskill experimental orchards where the cherry crop had been severely damaged in 2010.

Individual fruit obtained from untreated trees at Winters, CA, were placed into clear plastic containers on 4 sampling dates with the first sampling date corresponding to the beginning of grower harvest in the area. Before placing the fruit into the containers, they were evaluated for brix and surface pressure by Sarah Bradley Castro, graduate student in Dr. Ted Dejong's lab. There were 6 experimental treatments, intact 'French' prune with the stem attached, 'French' prune without the stem attached, 'French' prune without the stem attached and with a puncture wound made with a dissecting needle, 'French' prune without the stem attached and with the wax bloom removed, *Drosophila* diet vial (positive control). Ten female *D. suzukii* from lab colonies maintained in the Zalom lab at UC Davis were introduced to each treatment on each of 4 dates. In addition, 'French' prune without the stem attached and with no *Drosophila* introduced served as a negative control. There were 5 replicates for each sample date. The flies removed and counted at 72 hours. The containers and fruit were checked weekly for developmental status and allowed to develop for one month after which the fruit were destructively sampled to determine presence of remaining larvae or pupae that had not yet eclosed.

RESULTS AND CONCLUSIONS

We began monitoring *D. suzukii* in traps placed in the mixed plum block as in the mixed cherry block at Wolfskill after the cherries had already been infested and a normal harvest would have occurred, and found roughly similar numbers in traps placed in both blocks (Figures 1 and 2). This information led to concern by local growers and UCCE Farm Advisors that perhaps the soon to be ripening 'French' prune crop in the area might be at risk. The Zalom lab at UC Davis was asked to research the potential for infestation by *D. suzukii* by exposing ripe prunes to adult females in a no choice laboratory experiment, presumably the 'worst case' scenario where the only fruit available to the females were rip prunes. In response, an experiment was quickly designed that was largely conducted by undergraduate student assistant Heather Wilson under the direction of Frank Zalom and Kelly Hamby, a PhD student working on other *D. suzukii* research for her dissertation. Wilson had been assisting Hamby on her research for much or the previous year.

Our results indicated no significant difference between sample dates for fruit ‘ripeness’ (brix or surface pressure) or any measures of fly development. Mean brix was 25.6 ± 2.65 degrees and surface pressure 4.04 ± 0.54 psi. Had we started evaluating fruit before harvest had begun, these results might have been different. We combined fly development data for the 4 sampling dates and present summary data in Table 1. We observed that all life stages were observed on the outside of the prunes in the containers than on the prunes except for the treatment where the

prunes were wounded with the needle. The fewest eggs in total were laid on the prunes with the stems remaining. Very few larvae and pupae were found inside the prunes, even after destructive sampling a month after the fruit were exposed to the female *D. suzukii*. Extremely few adult flies successfully emerged from any of the prune treatments. Indeed, the *Drosophila* medium *control* produced significantly more adult flies than did any of the prune treatments.

From these results, we conclude that while *D. suzukii* is capable of going through a generation in prunes under no choice lab conditions, they are not an ideal food source. Further, normal prune handling/drying would not permit completion of a generation, and the harvest and rapid drying of prunes would not likely result in appreciable adulteration of the product, even under optimal conditions. Similarly, it is unlikely that *D. suzukii* would complete a generation on fresh prunes sent to market as mold and moisture became a significant problem later in our study. However, field conditions would be drier than in the lab, so it is possible that the flies cold complete a generation on unharvested or downed fruit remaining in the orchard. However, this has not been observed nor has this been tested experimentally.

We recommend that growers of 'French' prunes and other crops where *D. suzukii* have not yet been documented to be a problem not jump to conclusions on host susceptibility based on trap captures alone. However, until we have more conclusive evidence and additional years of experience with this new invader it remains wise to monitor for presence of *D. suzukii* by trapping, and if they are present to carefully observe fruit for any symptoms of infestation before making a treatment decision.

REFERENCES

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BUDGET SUMMARY

No funding was requested or received for this project.

FIGURES AND TABLES

Figure 1. *Drosophila suzukii* trap captures using apple cider vinegar in a liquid trap, Winters, CA, 2010.

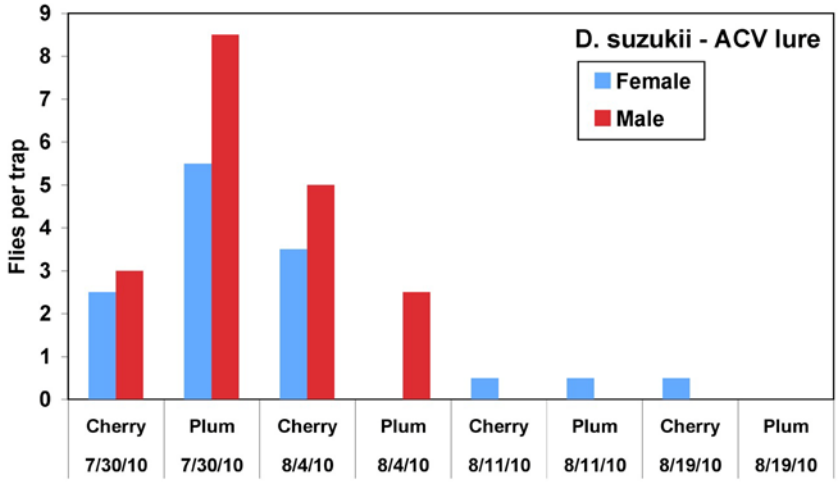

Figure 2. *Drosophila suzukii* trap captures using baker's yeast, sugar and water in a liquid trap, Winters, CA, 2010.

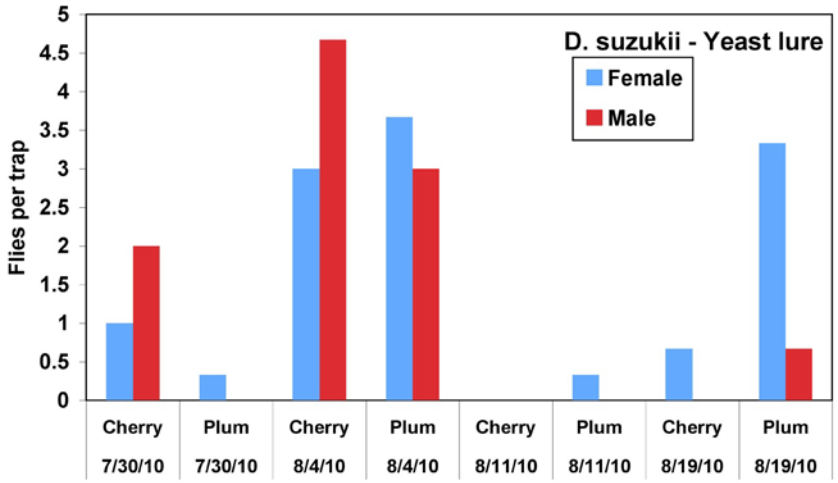

Table 1. *Drosophila suzukii* fecundity and development on 'French prune' in a no choice laboratory study.

Treatment	Mean±SD Flies Introduced	Mean±SD Eggs on Prune	Mean±SD Eggs on Container	Mean±SD Larvae Observed	Mean±SD Pupae Observed	Mean±SD Flies Eclosed
No Wax	10.0 ± 0.8	3.4 ± 2.4	8.9 ± 11.7	0.4 ± 0.4	0.9 ± 0.8	0.1 ± 0.2
Wax	10.3 ± 1.1	2.4 ± 1.3	3.7 ± 1.4	0.4 ± 0.5	0.6 ± 0.4	0.2 ± 0.2
Wax + Hole	8.8 ± 2.3	9.4 ± 1.1	3.7 ± 2.1	0.8 ± 0.3	0.6 ± 0.6	0.1 ± 0.2
Control	0.0	0.0	0.0	0.0	0.0	0.0
Stem Intact	7.4	0.2	2.2	0.2	0.4	0.2
Diet Vial	10.0 ± 0.0					18.1 ± 13.5