STUDY ON THE INTERACTION BETWEEN *DROSOPHILA SUZUKII* AND *DROSOPHILA MELANOGASTER* UNDER CONTROLLED CONDITIONS

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Abstract
This study examines the interaction between two species of drosophila, Drosophila suzukii *and* Drosophila melanogaster*, under laboratory conditions using raspberry fruits as a substrate.*
Eight 5-liter PET containers were used to observe population evolution over one month. The population dynamics were investigated at a nearly constant temperature of 21°C, and it was found that in all cases, Drosophila melanogaster *decimated the* Drosophila suzukii *population. The insects were temporarily exposed to low temperatures to reduce their activity and facilitate counting.*
Results suggest strong competition between the two species, negatively impacting D. suzukii*, and the 30-day period was sufficient to observe the complete disappearance of this species in the controlled experimental environment.*
Keywords: Drosophila suzukii, Drosophila melanogaster, competition, interaction, controlled environment

INTRODUCTION

Drosophila suzukii and *Drosophila melanogaster* are two important agricultural pest species known for attacking soft fruits.

Drosophila melanogaster is a small fly, approximately 2-3 mm long, with a yellow-brown body and bright red eyes. Males are distinguished by a black spot on the abdomen and shorter wings compared to females. This distinct appearance, along with its small size and specific coloration, facilitates identification in the laboratory and in the wild (Markow and O'Grady, 2006) (Figure 1).

Drosophila suzukii is similar in size to *D. melanogaster* but stands out due to unique characteristics, such as males' distinctive black spots on the anterior wing edge, which gives it the name "spotted wing drosophila." Females have a robust, toothed ovipositor adapted to pierce fresh fruit, contributing to its harmful impact on fruit crops (Cini et al., 2012; Hauser, 2011) (Figure 2).

Unlike *D. melanogaster*, *D. suzukii* lays its eggs in unripe fruit, affecting crops before ripening (Kenis et al., 2016).

D. melanogaster is more common, with a higher reproduction rate and shorter lifespan, allowing it to multiply rapidly in favorable conditions (Gress et al., 2016).

Figure 1. Drosophila melanogaster (Original)

Figure 2. Drosophila suzukii (Original)

MATERIALS AND METHODS

The raspberries used in the study were sourced from a 30 kg batch harvested in Perișor, Dolj (Figure 3).

Figure 3. Harvest raspberry batch (Original)

The study was conducted using eight 5-liter PET containers, each containing 10 *Drosophila suzukii* and 4 *Drosophila melanogaster* individuals, to observe population dynamics over the course of one month (figure 4).

Figure 4. PET Containers with D. melanogaster *and* D. suzukii *Larvae (Original)*

Each PET container's substrate consisted of raspberries treated with 0.1% Topsin 70 WDG solution (70% thiophanate-methyl) to extend the fruit's shelf life (Figure 5).

Figure 5. Fungicie used in this study (Original)

The fungicide treatment did not affect the insects.

The individuals were collected from 260 g of raspberries with visible damage due to *D. suzukii* attack, from a 30 kg batch (Figure 6).

Figure 6. Raspberries infested with Drosophila (Original)

The laboratory temperatures were maintained around 21°C throughout the study, with a maximum variation of 3°C, and observations were made every few days.

To facilitate counting, the PET containers were moved to a cold room, with gradual cooling from 20°C to 4°C over several hours to avoid thermal shock (Lee et al., 2011).

The temperature transition occurred in the following stages:

- From 20°C to 15°C in 2 hours
- From 15°C to 10°C in another 2 hours
- From 10°C to 4°C, where they remained for 30 minutes to become inactive and allow for accurate counting (Figure 7).

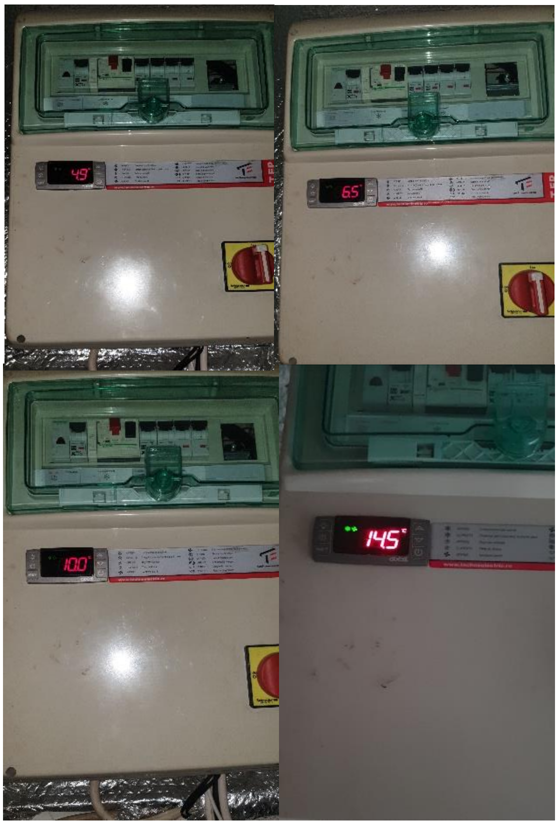

Figure 7. Refrigerated control unit (Original)

During monitoring, the insects were fed with treated raspberries stored in a 2-liter PET container (Figures 8 and 9).

Figure 8. Drosophila food (Original)

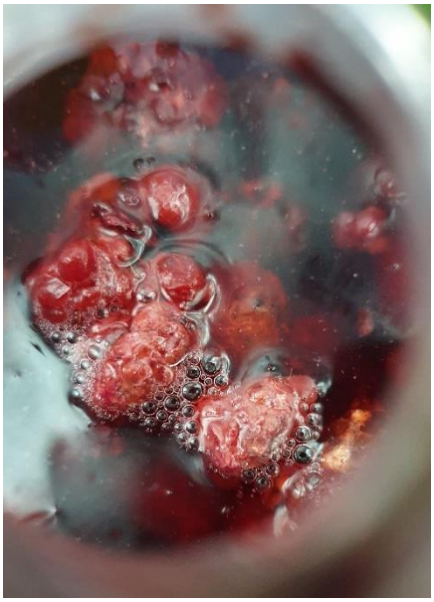

Figure 9. Raspberries used as food for Drosophila monitoring (Original)

RESULTS AND DISCUSSION

Over the 30-day monitoring period, a steady decline in the *Drosophila suzukii* population was observed in all PET containers, as shown in the table. With a shorter lifecycle and much faster reproduction rate, *Drosophila melanogaster* outnumbered *D. suzukii*, which could not compete effectively for available resources (Karageorgi et al., 2017).

Table 1. Monitoring of numerical evolution of Drosophila *individuals (Original)*

Day	**PET 1** D.s/D.m	**PET 2** D.s/D.m	**PET 3** D.s/D.m	**PET 4** D.s/D.m
1.	10/4	10/4	10/4	10/4
10.	8/10	9/12	8/13	7/14
15.	6/20	7/18	6/22	5/20
20.	3/30	4/28	3/34	2/30
25.	1/40	2/36	1/40	0/42
30.	0/48	0/45	0/50	0/48

Day	**PET 5** D.s/ D.m	**PET 6** D.s/ D.m	**PET 7** D.s/ D.m	**PET 8** D.s/ D.m	**Average**
1.	10/4	10/4	10/4	10/4	**10/4**
10.	8/10	9/13	7/14	8/12	**8/12**
15.	6/19	6/21	4/22	5/20	**5,6/20,2**
20.	3/32	3/31	2/34	3/30	**2,8/31,1**
25.	1/38	1/41	0/43	1/40	**0,8/40**
30.	0/50	0/49	0/51	0/48	**0/48,6**

The data collected during the one-month study can also be visualized in the form of a graph, clearly illustrating how *Drosophila melanogaster* outcompetes and ultimately causes the disappearance of *Drosophila suzukii* in a survival competition (figure 10).

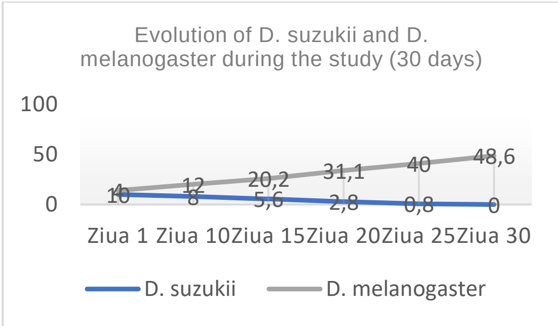

Figure 10. Graph of numerical evolution of Drosophila *individuals (Original)*

At a temperature of 21°C, the lifecycle of *D. melanogaster* is approximately 12 days, and females can lay up to 500 eggs per week, which develop in 8 days (Gress et al., 2016). In comparison, *D. suzukii*, with a lifecycle of 20 days and a reproduction rate of 21 eggs per day, was unable to compete effectively in the same environment (Kenis et al., 2016)

The results of this study confirm similar research that has investigated the interaction between *D. suzukii* and *D. melanogaster*. For example, Karageorgi et al. (2017) demonstrated that *D. melanogaster* dominates over other species in competitive environments due to its ability to rapidly colonize the substrate and its high reproduction rate. Another study by Atallah et al. (2014) confirmed that *D. melanogaster* can survive and thrive in environments with intense competition for resources, a phenomenon also observed in this study's experiment. Similarly, Gress et al. (2016) showed that *D. suzukii* faces challenges in competing with other *Drosophila* species due to its longer lifecycle and lower reproduction rate. This study adds to this body of research and confirms that, under similar conditions, *D. melanogaster* can completely eliminate *D. suzukii* within a month.

CONCLUSIONS

This study demonstrated that *Drosophila melanogaster* has a major competitive advantage over *Drosophila suzukii* in laboratory conditions with limited resources.

The rapid reproduction rate and short lifecycle of *D. melanogaster* allow it to outnumber and eliminate *D. suzukii* in a shared environment.

The study's results align with similar research (Karageorgi et al., 2017; Gress et al., 2016) indicating that *D. melanogaster* is more efficient at exploiting food resources. These observations could have implications for integrated pest management, where *D. melanogaster* might limit the spread of *D. suzukii* in agricultural crops.

Although this study was conducted under controlled laboratory conditions, the results provide insights into the interactions between these two species in resource-limited environments, similar to natural ecosystems and agricultural fields. The competitive ability of D. melanogaster to quickly colonize and deplete available food resources may help limit populations of D. suzukii, a known pest of soft fruits including raspberries, strawberries, and blueberries (Asplen et al., 2015).

These findings could support the development of biological control strategies that incorporate interspecific competition to reduce the economic impact of D. suzukii infestations, thereby helping to protect valuable crops and reduce insecticide use.

REFERENCES

Asplen, M. K., Anfora, G., Biondi, A., Choi, D. S., Chu, D., Daane, K. M., Gibert, P., Gutierrez, A. P., Hoelmer, K. A., Hutchison, W. D., Isaacs, R., Jiang, Z. L., Kárpáti, Z., Kimura, M. T., Pascual, M., Philips, C. R., Plantamp, C., Ponti, L., Vétek, G., Vogt, H., Walton, V. M., Yu, Y., Zappalà, L., & Desneux, N. (2015). *Invasion biology of spotted wing Drosophila (Drosophila suzukii): a global perspective and future priorities*. Journal of Pest Science, 88(3), 469-494.

Atallah, J., Teixeira, L., Salazar, R., Zaragoza, G., & Kopp, A. (2014). The making of a pest: insights from the evolution of chemosensory receptor families in a pestiferous and invasive fly, *Drosophila suzukii*. *BMC Genomics*, 15(1), 1-16.

Cini, A., Ioriatti, C., & Anfora, G. (2012). *A review of the invasion of Drosophila suzukii in Europe and a draft research agenda for integrated pest management*. Bulletin of Insectology, 65(1), 149-160.

Gress, B. E., Smith, R. J., & Emerson, K. J. (2016). Population dynamics of *Drosophila suzukii* in fruit orchards: Implications for control strategies. *Journal of Economic Entomology, 109(4), 1567-1574.*

Hauser, M. (2011). A historic account of the invasion of Drosophila suzukii (Matsumura) in the continental United States, with remarks on their identification. Pest Management Science, 67(11), 1352-1357.

Karageorgi, M., Bräcker, L. B., Lebreton, S., Minervino, C., Cavey, M., Siju, K. P., Grunwald Kadow, I. C., & Prud'homme, B. (2017). Evolution of multiple sensory systems drives novel egg-laying behavior in the fruit pest *Drosophila suzukii*. *Current Biology*, 27(6), 847-853.

Kenis, M., Tonina, L., Eschen, R., Van der Sluis, B., Sigsgaard, L., Bolckmans, K., & Haye, T. (2016). Integrated management of *Drosophila suzukii* in fruit crops: New insights and future perspectives. *Journal of Pest Science*, 89(3), 621-630.

Lee, J. C., Bruck, D. J., Curry, H., Edwards, D. L., Haviland, D. R., Van Steenwyk, R. A., & Yorgey, B. M. (2011). The susceptibility of small fruits and cherries to the spotted-wing drosophila, *Drosophila suzukii*. *Pest Management Science*, 67(11), 1358-1367.

Markow, T. A., & O'Grady, P. M. (2006). *Drosophila: A Guide to Species Identification and Use*. Academic Press.