Аграрен университет – Пловдив, Научни трудове, т. LXVII, кн. 1, 2025 г.
Юбилейна научна конференция *„80 години Аграрен университет – Пловдив: Традиции срещат иновации “*
Anniversary Scientific Conference
"80 Years Agricultural University – Plovdiv:Traditions Meet Innovations"
Agricultural University – Plovdiv, Scientific Works, vol. LXVII, book 1, 2025

DOI: 10.22620/sciworks.2025.02.001

MODERN APPROACHES TO REDUCING DAMAGE CAUSED BY *DROSOPHILA SUZUKII* (MATSUMURA) IN STRAWBERRIES
СЪВРЕМЕННИ ПОДХОДИ ЗА ОГРАНИЧАВАНЕ НА ВРЕДАТА ОТ *DROSOPHILA SUZUKII* (MATSUMURA) ПРИ ЯГОДИ

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Abstract

Drosophila suzukii (Matsumura 1931) is an economically important pest of berry crops worldwide. Unlike most species of the genus Drosophila, this species lays its eggs in healthy, ripening fruits, leading to significant yield losses and reduced commercial quality of the produce. The present study was conducted during the period 2023–2025 in the village of Mirolyubovo, Burgas region, in a strawberry plantation of the cultivar Petra, covering an area of 0.2 ha. The aim was to apply environmentally friendly approaches to limit the population density and damage caused by *D. suzukii.* To monitor pest population dynamics, food traps were installed, and nets were used to restrict the entry of the species into the crop area. Observations were carried out from the beginning of fruit ripening until harvest, recording the number of trapped adult flies and the percentage of damaged fruits.

The results of the study show that combining physical barriers with food traps significantly reduces infestation by *D. suzukii* —approximately 50% fewer damaged fruits were recorded compared to the control plots. The application of integrated control methods can effectively reduce the damage caused by this pest and decrease the need for chemical treatments.

Keywords: *Drosophila suzukii*, strawberries, traps, nets, integrated pest management

Резюме

Drosophila suzukii (Matsumura, 1931) е икономически важен неприятел по ягодоплодни култури в световен мащаб. За разлика от повечето видове от рода Drosophila, този вид снася яйцата си в здрави, узрели плодове, което води до значителни загуби на добив и понижаване търговското качество на продукцията. Настоящото проучване е проведено през периода 2023–2025 г. в село Миролюбово, област Бургас, в насаждение с ягоди сорт Петра на площ

от 0.2 ha. Целта е да се приложат екологосъобразни подходи за ограничаване на числеността и вредата от *D. suzukii.* За проследяване популационната плътност на неприятеля се заложиха хранителни уловки, както и мрежи за ограничаване навлизането на вида към вътрешността на посева. Наблюденията са провеждани от началото на узряването до прибирането на реколтата, като са отчетени броят на уловените възрастни индивиди и процентът повредени плодове.

Резултатите от проведеното проучване показват, че комбинирането на физически бариери с хранителни уловки води до значително намаляване на нападението от *D. suzukii* – отчетен е приблизително 50% по-малко повредени плодове в сравнение с контролните участъци. Прилагането на интегрирани методи за контрол може успешно да ограничи вредата от този неприятел и да намали необходимостта от химични третирания.
Ключови думи: *Drosophila suzukii*, ягоди, уловки, мрежи, интегрирана растителна защита

INTRODUCTION

In recent years, *Drosophila suzukii* (Matsumura) has become one of the most significant pests of berry crops in Europe and worldwide. It causes considerable economic losses in the production of strawberries, raspberries, and cherries, as the larvae develop inside the fruit, reducing its market value (Cini et al., 2012). The extensive use of insecticides for the control of *D. suzukii* leads to the development of resistance and poses a risk of pesticide residues in the fruits. Therefore, there is a growing need to develop integrated control methods that combine food traps, physical barriers, and cultural practices. Monitoring the population of *D. suzukii* is a key component of integrated pest management systems. The use of food traps or specific attractants allows for early detection of adult individuals and tracking of population dynamics (Wilson, 2017). According to Cruz-Esteban et al. (2021), the effectiveness of food traps depends mainly on the composition of the attractant rather than the trap's shape. Studies have shown that combinations of wine vinegar, yeast, and sugar solutions attract the highest number of individuals. Nets are widely used in agriculture to protect crops from abiotic and biotic factors. Since the mid-20th century, they have also been applied for crop protection against pests (Chouinard et al., 2019). These nets are made of transparent threads with small openings (1–7 mm in diameter) and serve as protection against insects (Briassoulis and Mostriotis, 2007). They are used by growers as an alternative control tool, especially in organic farming. Several authors (Hanson et al., 2016; Leach et al., 2016; Alnajjar et al., 2017) report that nets are an effective means of reducing *D. suzukii* damage in berry crops while simultaneously decreasing the use of insecticides. Nets with a mesh size of 1.0 mm limit the ability of female flies to enter the plantations. Kuesel et al. (2023) demonstrated that the use of nets in raspberry plantations resulted in a 75% reduction in infestation and increased yields under organic production. Similar results were reported by Dominique et al. (2019) for grapes, where nets reduced the number of trapped adults and the damage to grape clusters. Integrated control systems for *D. suzukii* include physical, monitoring, and cultural practices. Cahenzli and Boutry (2022) state that the combination of nets, food traps, and timely

removal of damaged fruits reduces infestation levels in organic orchards. Gong et al. (2016) found that certain strawberry cultivars exhibit lower susceptibility to infestation, suggesting the potential for breeding resistant varieties.

MATERIALS AND METHODS

The present study was conducted during the period 2023–2025 in the village of Mirolyubovo, Burgas region, in a strawberry plantation of the cultivar “Petra,” covering an area of 0.2 ha. To monitor the occurrence and population density of the pest, food traps were used in two fields—one covered with nets and one without nets. Plastic containers were filled with the food attractant “Suzukii Trap” produced by the Spanish company Bioiberica. The traps were placed in the middle of the rows, both along the edges and in the center of the field, at the beginning of fruit ripening. In the first field, nets were installed around the plantation to limit the entry of the species into the interior. Infestation by *Drosophila suzukii* was determined through visual observations. Fruit damage in the fields with and without nets was assessed on 100 randomly selected plants.

RESULTS AND DISCUSSION

The occurrence of *Drosophila suzukii* on strawberries of the cultivar “Petra” in 2023 was recorded at the beginning of June, coinciding with the onset of fruit ripening. A total of six individuals were captured using the Suzukii Trap (Fig. 1). As the pest began to invade the crop and fruit ripening progressed, its population density gradually increased. The highest number of *D. suzukii* individuals was recorded during the second ten-day period of July—corresponding to the stage of full fruit ripening—when 53 individuals were captured. At that time, the sugar content of the fruits measured in °Brix was 10.2%. This parameter is an important factor for the development of *D. suzukii* larvae and corresponds with the findings of Ioriatti et al. (2015), who emphasize the significance of sugar content for the successful development of the species.

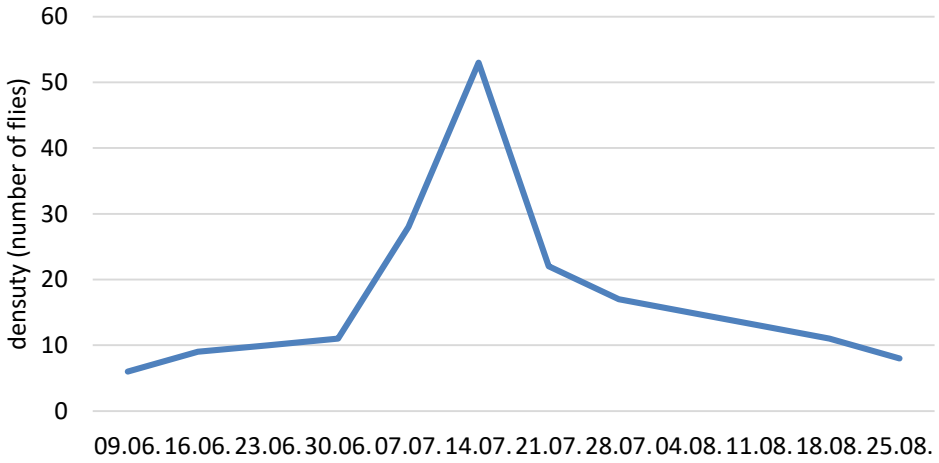

Fig. 1. Population dynamics of *D. suzukii* on strawberries, cultivar “Petra,” in 2023 in the region of Mirolyubovo village

According to Lee et al. (2011), in the strawberry cultivars ‘Hood’ and ‘Totem,’ the highest number of eggs and larvae were observed in partially or fully colored fruits, which are characterized by higher sugar content and firmer texture compared to green fruits (Arnó et al., 2016). The volatile compounds released during ripening also play an important role in attracting adult individuals. Keesey et al. (2015) reported that more than 360 volatile organic compounds specific to different strawberry cultivars have been identified, which act as attractants for *D. suzukii*. In 2024, the first adults of *D. suzukii* on the cultivar “Petra” were again detected at the beginning of June—four individuals (Fig. 2). As temperatures increased and the fruit ripening period began, the number of flies rose, reaching 44 individuals during the third ten-day period of July. During this time, the soluble solids content of the fruits was 8.4% °Brix. With the completion of harvesting and the reduction of the available food source, the population density in the traps gradually declined.

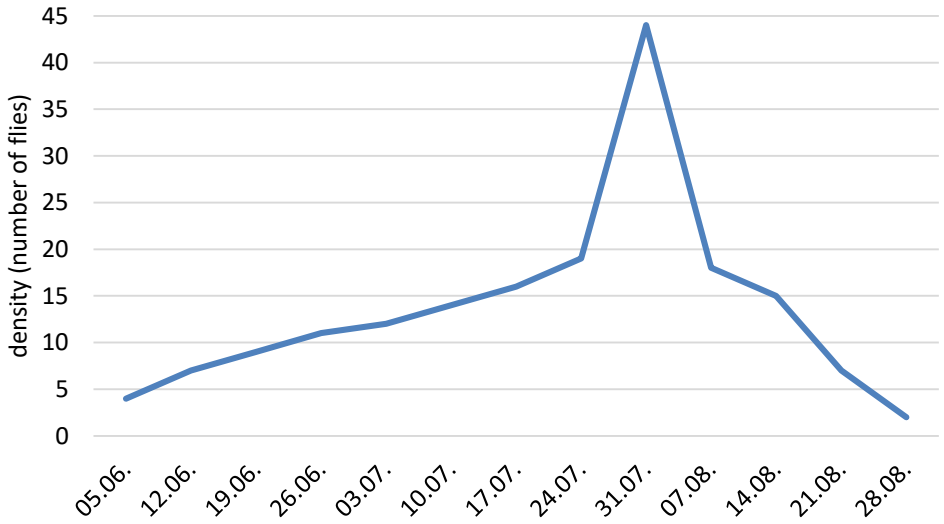

Fig. 2. Population dynamics of *D. suzukii* on strawberries, cultivar “Petra,” in 2024 in the region of Mirolyubovo village

In 2025, the population dynamics of *D. suzukii* showed a similar trend (Fig. 3). During the first week of June, a low density was recorded—five individuals. At the end of June, a decrease in population density was observed, followed by a pronounced increase in the second half of July, when the first peak occurred (approximately 17 individuals).

This period coincides with the mass ripening of fruits and favorable temperature conditions for the development of the species. During the first half of August, a second, more pronounced population peak was recorded—around 22 individuals—which was likely due to the presence of residual fruits in the crop. At the end of August, the population sharply decreased to four individuals, corresponding to the end of the vegetation period and the limited availability of food resources.

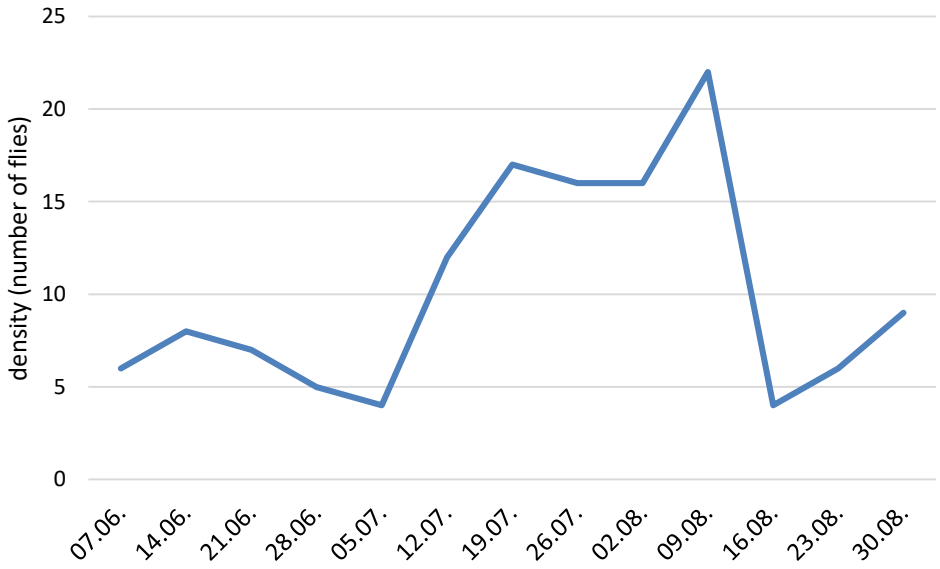

Fig. 3. Population dynamics of *D. suzukii* on strawberries, cultivar "Petra," in 2025 in the region of Mirolyubovo village

In the last week of August, a slight increase was observed, probably related to a drop in temperatures and the presence of alternative hosts in the surrounding area. In the Burgas region, *Drosophila suzukii* appears annually at the beginning of June, coinciding with the onset of fruit ripening. The highest population density is observed in the second half of July—during the full ripening stage—when the conditions (temperature, humidity, and sugar content of the fruits) are most favorable. The highest pest density was recorded in 2023 (53 individuals), followed by 2024 (44 individuals) and 2025 (22 individuals). The differences between the years can be explained by variations in climatic conditions, the presence of alternative hosts, and the applied agrotechnical practices. Climatic factors play a key role in the development and population dynamics of *D. suzukii.* During the period 2023–2025, the summer temperatures in the Burgas region were favorable for the reproduction and development of the pest—the daily values averaged between 22°C and 30°C, which corresponds to the optimal temperature range for the species' life cycle (Lee et al., 2011; Ioriatti et al., 2015). Higher temperatures and prolonged dry periods in July 2023 contributed to the higher maximum population density (53 individuals), whereas the cooler and more humid summer of 2025 may explain the lower density levels (maximum 22 individuals). Humidity affects the survival of eggs and larvae, while drought or heavy rainfall can also limit the population. In addition to temperature, regular rainfall during August 2024 and 2025 likely influenced the reduction in population density by limiting the activity and survival of larvae within the fruits.

From Fig. 4 it can be seen that the average daily temperature shows a slight increasing trend from 2023 to 2025, especially in July (from 24.9°C in 2023 to 26.4°C in 2025).

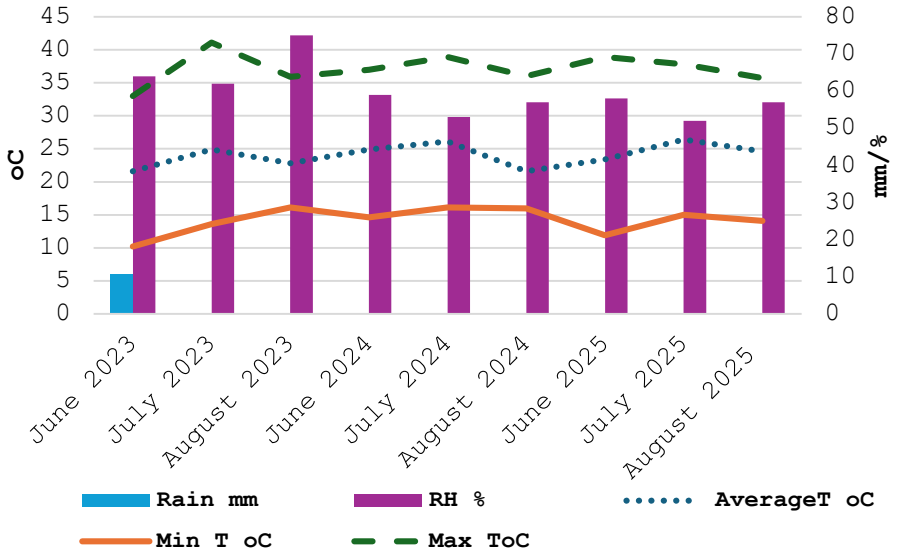

Fig. 4. Climatic indicators for the Mirolyubovo region (2023–2025)

The maximum temperatures were highest in July 2023 (41.1°C) and remained around 37–39°C in the following years. The minimum temperatures also showed a slight increase. During the reporting period, an overall lack of rainfall was observed. Only in June 2023 was a total of 10.5 mm recorded, while all other months were completely dry. From Fig. 5 it is evident that the number of captured adult *D. suzukii* individuals was significantly lower in the fields covered with nets compared to the control plots (fields without nets) throughout all study years.

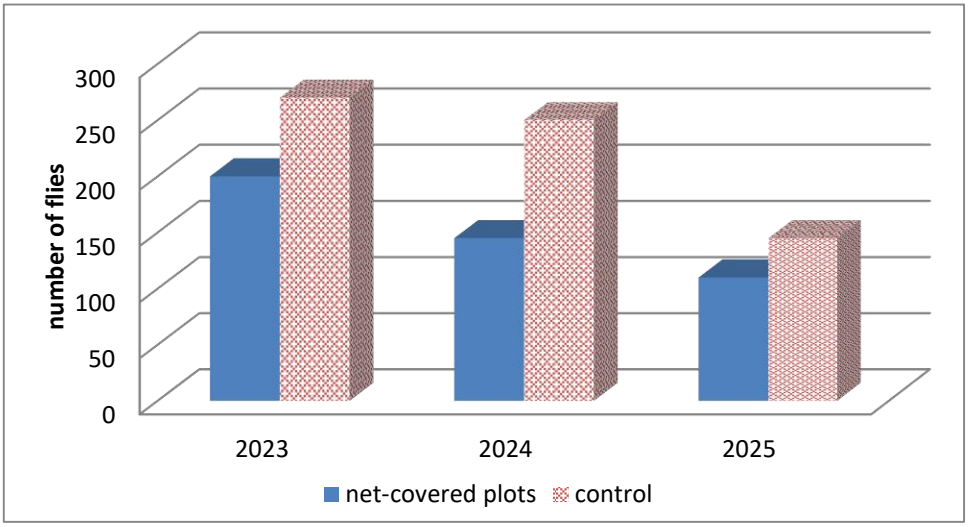

Fig. 5. Captured adults of *Drosophila suzukii* on strawberries, cultivar 'Petra,' in fields with and without nets during 2023–2025 in the Mirolyubovo region

In 2023, a total of about 200 adults were captured in the net-covered fields, while the control fields (without nets) recorded nearly 270 individuals — a difference of approximately 26%. In 2024, the difference became even more pronounced, with about 145 individuals in the net-covered fields compared to 250 in the uncovered plots, representing nearly 42% fewer flies in the protected areas. In 2025, the number of adults captured in the net-covered fields was around 110, compared to about 135 in the control, reducing the difference to approximately 18%. This decrease was likely due to the overall population decline observed that year; however, the nets still maintained their protective effect. The use of nets reduced the *D. suzukii* population by an average of 25–40% over the study period, confirming the effectiveness of this method for pest suppression in strawberry plantations. The obtained data on the use of exclusion nets to prevent pest entry into the crops are consistent with the findings of other researchers (Hanson et al., 2016; Leach et al., 2016a; Rogers et al., 2016; Alnajjar et al., 2017). Along with monitoring the population density of *D. suzukii* in the strawberry fields, the percentage of damaged fruits was also recorded. In 2023, the percentage of damaged fruits in the net-covered fields reached about 13%, while in the control plots it was significantly higher — 17%. In 2024, the trend remained similar — 8% damaged fruits in the net-covered fields versus 12% in the control. In 2025, the lowest percentage of fruit damage was recorded in both variants, but the difference remained significant — 3% in the net-covered fields and 6% in the uncovered ones. These results confirm that covering strawberry crops with protective nets is an effective method for reducing damage caused by *D. suzukii,* while simultaneously improving fruit quality and yield.

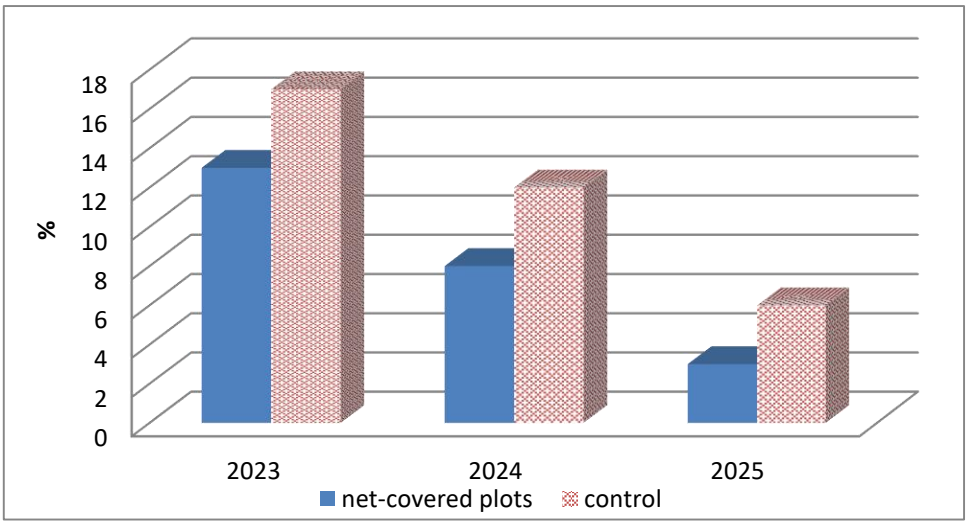

Fig. 6. Damaged fruits by *Drosophila suzukii* in fields with and without nets during 2023–2025 in the Mirolyubovo region

The obtained data are consistent with literature reports. The use of nets in berry crops reduces damage caused by *Drosophila suzukii* (Hanson et al., 2016; Leach et al., 2016a; Rogers et al., 2016; Alnajjar et al., 2017).

CONCLUSIONS

Based on the conducted study, the following conclusions can be drawn:

- The number of adults captured in net-covered fields was significantly lower compared to fields without nets. In 2023, population density in net-covered fields decreased by 26%, in 2024 by 42%, and in 2025 by 18%. This confirms that nets are an effective physical barrier against the pest, reducing its spread and population density.
- The percentage of damaged fruits was also significantly lower in net-covered fields. Over the three years, fruit damage in fields with nets ranged between 3% and 13%, while in fields without nets it ranged from 6% to 17%. This demonstrates that reducing fly density through netting leads to a substantial decrease in fruit damage.
- The use of protective nets is a reliable and effective method for controlling *D. suzukii* in strawberry cultivation, contributing to improved fruit quality and reduced losses.

REFERENCES

Arnó, J., Gómez-Cortecero, A., & Gabarra, R. (2016). Influence of strawberry fruit characteristics on oviposition by *Drosophila suzukii*. Journal of Pest Science, 89(2), 385–393.

Alnajjar, G., Jensen, A. S., & Isaacs, R. (2017). Use of exclusion netting for spotted wing Drosophila (*Drosophila suzukii*) management in small fruit crops. Insects, 8(4), 118. https://doi.org/10.3390/insects8040118.

Arnó, J., Solà, M., Riudavets, J., & Gabarra, R. (2016). Population dynamics, non-crop hosts, and fruit susceptibility of *Drosophila suzukii* in Northeast Spain. Journal of Pest Science, 89, 713–723.

Briassoulis, D., & Mistriotis, A. (2007). Mechanical behaviour and properties of agricultural nets — Part I: Testing methods for agricultural nets. Polymer Testing, 26, 822–832.

Cahenzli, F., & Boutry, S. (2022). Integrated pest management strategies for *Drosophila suzukii* in organic fruit production. Agricultural Systems, 195, 103292. https://doi.org/10.1016/j.agsy.2021.103292

Chouinard, G., Veilleux, J., Pelletier, F., Larose, M., Philion, V., Joubert, V., & Cormier, D. (2019). Impact of exclusion netting row covers on 'Honeycrisp' apple trees grown under Northeastern North American conditions: Effects on photosynthesis and fruit quality. Insects, 10(7), 214. https://doi.org/10.3390/insects10070214

Cini, A., Ioriatti, C., & Anfora, G. (2012). *Drosophila suzukii* (Matsumura), a globally emerging pest of soft fruits: Biology, ecology and impact. Bulletin of Insectology, 65(1), 149–160.

Cruz-Esteban, S., Garay-Serrano, E., & Rojas, J. C. (2021). The attractant, but not the trap design, affects the capture of *Drosophila suzukii* in berry crops. Journal of Economic Entomology, 114(1), 152–160.

Gong, X., Bräcker, L., Bölke, N., Plata, C., Zeitlmayr, S., Metzler, D., Olbricht, K., Gompel, N., & Parniske, M. (2016). Strawberry accessions with reduced

Drosophila suzukii emergence from fruits. Frontiers in Plant Science, 7, 1880. https://doi.org/10.3389/fpls.2016.01880

Hanson, E. J., Isaacs, R., & Gut, L. J. (2016). Exclusion netting delays and reduces *Drosophila suzukii* infestation in raspberries. HortTechnology, 26(3), 291–295. https://doi.org/10.21273/HORTTECH.26.3.291

Ebbenga, D. N., Burkness, E. C., & Hutchison, W. D. (2019). Evaluation of exclusion netting for spotted-wing drosophila (Diptera: Drosophilidae) management in Minnesota wine grapes. Journal of Economic Entomology, 112(5), 2287–2294. https://doi.org/10.1093/jee/toz143

Ioriatti, C., Walton, V. M., Dalton, D. T., Anfora, G., Grassi, A., Maistri, S., & Mazzoni, V. (2015). *Drosophila suzukii* (Diptera: Drosophilidae) and its potential impact on European soft fruit production. Bulletin of Insectology, 68(1), 161–173.

Keesey, I. W., Knaden, M., & Hansson, B. S. (2015). Olfactory specialization in *Drosophila suzukii* supports an ecological shift in host preference. Chemical Senses, 40(2), 93–103. https://doi.org/10.1093/chemse/bjv070

Kuesel, R., Avery, C., Jones, S., Gauger, A., Scott, D., & Gonthier, D. (2023). Fine-mesh exclusion netting reduces *Drosophila suzukii* (Diptera: Drosophilidae) infestation and improves organic fall-bearing raspberry yields. Journal of Economic Entomology, 116(5), 1727-1736. https://doi.org/10.1093/jee/toad151

Leach, H., Van Timmeren, S., Wetzel, W., & Isaacs, R. (2016). Exclusion netting delays and reduces *Drosophila suzukii* (Diptera: Drosophilidae) infestation in raspberries. Journal of Economic Entomology, 109(5), 2151-2158. https://doi.org/10.1093/jee/tow117

Lee, J. C., Bruck, D. J., Dreves, A. J., Ioriatti, C., Vogt, H., & Baufeld, P. (2011). In focus: Spotted wing Drosophila, *Drosophila suzukii*, across perspectives. Pest Management Science, 67(11), 1349–1351. https://doi.org/10.1002/ps.2266

Rogers, M., Leach, H., Hanson, P., Alnajjar, G., et al. (2019). Evaluation of exclusion netting for spotted-wing drosophila (Diptera: Drosophilidae) management in Minnesota wine grapes. Journal of Economic Entomology, 112(5), 2287-2294. https://doi.org/10.1093/jee/toz143.

Wilson, C. (2017). A review of the monitoring and management of spotted-wing drosophila (*Drosophila suzukii*) in lowbush blueberries. Proceedings of the Nova Scotian Institute of Science, 49(1), 145-160.