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Short communication

Use of dead-end plants in orchards: A potential strategy to control *Drosophila suzukii*?

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Abstract

The invasive pest Drosophila suzukii poses a significant threat to several fruit crops worldwide. End consumers are increasingly expressing concerns about chemical crop protection products due to their environmental impact. This study evaluates the potential of so-called dead-end plants as ecological traps for D. suzukii to reduce population density. In a series of controlled choice-tests, the preference for oviposition and complete development to imago of D. suzukii on selected dead-end plants was investigated and compared to blueberries as a standard host. Fruits of Phytolacca acinosa, Pyracantha coccinea, Cornus mas, Prunus laurocerasus, Cornus sanguinea and Cotoneaster divaricatus were tested as potential dead-end plants. The data suggest that certain plant characteristics may discourage successful development of D. suzukii larvae, potentially offering a non-chemical approach for pest management. Further research is needed to refine plant selection criteria and optimize the implementation of dead-end plants in practical agricultural settings.

Keywords: dead-end plants, ecological trap, *Drosophila suzukii*, conservation biological control

Introduction

The global impact of *Drosophila suzukii*, commonly known as the spotted-wing drosophila (SWD), on fruit crops necessitates sustainable pest control strategies. This invasive species, capable of penetrating intact fruits to deposit its eggs, leads to significant crop losses and quality reduction. It has also high adaptability to diverse climatic conditions, further facilitating its widespread distribution (Asplen et al. 2015). In this context, investigating the potential of so-called "dead-end plants" with limited reproductive success for the flies (Poyet et al. (2015), emerges as a potential promising strategy in combination with other sustainable approaches like integrating natural enemies (Shaw et al. 2021). This study aims to assess whether such plants can serve as ecological traps to reduce the natural occurring population of *D. suzukii* in areas with berry and fruit cultivation. We tested fruits of potential dead-end plants against blueberries as standard host in a series of controlled choice tests. The findings of this research may not only deepen our understanding of *D. suzukii* behaviour but also offer sustainable alternatives to conventional pest control methods. The exploration of ecological traps using dead-end plants presents an environmentally friendly and integrated approach to mitigating the challenges posed by *D. suzukii* in agricultural systems. By investigating plant-insect interactions, this study contributes to a holistic and environmentally conscious perspective on managing invasive pests in fruit orchards.

Material and Methods

A choice test was carried out with blueberries (*Vaccinium myrtillus*) as the standard host. *Phytolacca acinosa*, *Pyracantha coccinea*, *Cornus mas*, *Prunus laurocerasus*, *Cornus sanguinea* and *Cotoneaster divaricatus* were selected as potential dead-end plants. According to the respective ripening time of the plants, their fruits were collected in the field

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on the campus of Hochschule Geisenheim University. The fruits were then checked for naturally occurring ovipositions of drosophilids. Only fruits without already existing ovipositions were used. The experiment took place in 90 x 45 x 45 cm cages under controlled conditions. A total of 4 blueberries and 4 test fruits were placed in each cage. As a control, 8 blueberries were used per cage. In total 16 replicates were performed per test fruit. Five male and five female 5 to 8 days old flies were released in the centre of the cage and left there for 24 hours. The ovipositions on the fruits were then counted under a binocular and incubated for 14 to 18 days at room temperature. Finally, the number of fully developed adult flies was determined. R was used for the statistical analysis.

In addition, for field-collected fruits with already existing ovipositions, numbers of eggs per fruit were counted and fruits were incubated under room conditions to assess adult development. Furthermore, adult flies were also morphologically determined and species were confirmed via PCR with a species-specific primer (Wolf et al. 2018).

Results and Discussion

The choice test showed that *D. suzukii* could not fully develop in fruits of *P. acinosa* (Tab. 1). For the fruits of *C. divaricatus*, *C. sanguinea*, *P. coccinea* and *P. laurocerasus*, only a tendency towards a reduced number of fully developed adults was observed (data not shown).

Table 1: Mean value (Ø) and standard deviation (SD) of the number of ovipositions and fully developed SWD, as well as the rate of fully developed SWD in the choice test cages (A) with *P. acinosa* and *V. myrtillus* fruits (n = 16) compared to control cages (B) with *V. myrtillus* only (n = 16).

Choice cage	Ø No. of ovipositions	SD	Ø No. of fully developed SWD	SD	Rate of fully developed SWD [%]
A	9,38	7,42	3,69	3,05	39,33
A	3,25	3,77	0,00	0,00	0,00
B	4,13	3,93	1,94	1,77	46,97
B	6,88	9,21	3,38	4,56	49,09

The incubation of field-collected fruits of potential dead-end plants with already naturally existing ovipositions resulted in the following rates for the full development of flies from their fruits (Tab. 2): 55.93 % from *C. sanguinea*, 22.15 % from *C. divricatus*, 18.54 % from *P. laurocerasus*. No natural ovipositions were found on the fruits of *P. acinosa* and *P. coccinea*. The data on *C. mas* could not be evaluated due to heavy mould infestation.

Table 2: Evaluation of already naturally existing ovipositions on field-collected fruits of potential dead-end plants by the spotted-wing drosophila (SWD) or other species.

	Number of						Rate of fully developed SWD [%]	Number of other species
Dead end plant	fruits	ovipo-sitions	Ø	♀ SWD	♂ SWD	total		
C. divaricatus	87	158	1,82	20	15	35	22,15	1
C. sanguinea	48	59	1,23	20	13	33	55,93	1
P. laurocerasus	238	766	3,22	80	62	142	18,54	14

The results show that there is a clear difference between the data from the choice test in an artificial environment and the number of eggs laid under natural conditions. The use of choice tests in the laboratory compared to scoring data from nature under realistic conditions raises important questions regarding the transferability of laboratory results to natural environments, particularly in the context of *D. suzukii* oviposition behaviour. Laboratory trials provide precise control over experimental conditions and allow detailed analysis of specific factors. The precise reproducibility of conditions in the laboratory facilitates the isolation of cause-effect relationships and facilitates comparison between different conditions. However, this control may result in an artificial environment that could interfere with the natural behaviour of *D. suzukii*. Scoring data from nature provides a broader perspective that considers the complexity of natural ecosystems. These data capture interactions with real-world environmental factors such as temperature fluctuations, natural plant chemicals and seasonal changes. This allows for a more comprehensive assessment of the actual behaviour of *D. suzukii* in its natural habitat.

Overall, the critical discussion of these two methods requires a balanced understanding of the advantages and disadvantages of each approach in order to draw robust and comprehensive conclusions regarding the behaviour of *D. suzukii* with regard to choosing a potential host plant for oviposition.

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