

## ***Trissolcus cultratus* as a biological control agent for *Pentatoma rufipes* L. in organic pome fruit orchards**

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### **Abstract**

*The red-legged stink bug *Pentatoma rufipes* has emerged as a significant pest in European pome fruit orchards, causing substantial damage to apple and pear production. From 2022 to 2025, field trials were conducted in heavily infested organic orchards to evaluate the efficacy of the native egg parasitoid *Trissolcus cultratus* as a biological control agent. Inundative releases of 30–45 parasitoids per dispenser effectively reduced nymph populations by 88–93% and increased marketable yield by up to 26% in plots complemented with flower strips. Long-term monitoring confirmed that the parasitoid successfully established, and dispersed within the orchards, while targeted low-density releases at orchard edges demonstrated an efficient strategy for reducing pest populations at the beginning of the infestation using minimal numbers of parasitoids. These findings emphasize the potential of *T. cultratus* as an important tool in the management of the red legged stinkbug.*

**Keywords:** *Pentatoma rufipes*, *Trissolcus cultratus*, biological control, integrated pest management

### **Introduction**

The red-legged stink bug *Pentatoma rufipes* L. (Hemiptera: Pentatomidae) is widely distributed throughout Europe and was long considered a forest associated species of little economic importance for fruit growing. It is a polyphagous insect feeding with piercing sucking mouthparts on leaves, buds, flowers, and fruits of numerous host plants. During the last decade, however, *P. rufipes* has increasingly gained importance as an agricultural pest, particularly in fruit orchards, indicating a clear shift in its ecological status (Koenig, 2014; Kehrlı & Pasquier, 2012; Peusens & Beliën, 2012).

Economic damage caused by *P. rufipes* was first reported mainly in pear orchards across several European countries (Koenig, 2014; Powell, 2020). In southern Germany, monitoring programs initiated in 2017 documented a growing presence of this species in apple orchards, and in 2019 fruit damage in apple attributable to spring occurring nymphs was observed for the first time (Al karrat et al., 2020). These findings confirmed apple as a host crop and highlighted the increasing relevance of *P. rufipes* as a pest in pome fruit production. High natural parasitism of *P. rufipes* eggs by the native egg parasitoid *Trissolcus cultratus* (Hymenoptera: Scelionidae) has been reported in orchard ecosystems (Al karrat et al., 2020, 2022). This parasitoid, which produces several generations per year, is also able to successfully use other hosts such as *Palomena prasina* and *Graphosoma lineatum*. This is important for its success in reducing also low numbers of *P. rufipes* populations.

### **Material and Methods**

**Field Trials – Apple and Pear Orchards:** Field trials were conducted from 2022 to 2024 in heavily infested organic apple and pear orchards to determine the optimal release strategy of *Trissolcus cultratus* for controlling *Pentatoma rufipes*. Plots consisted of six to

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eight rows with 35 trees per row, separated from untreated control plots by a buffer of approximately 30 trees. Outer rows were not sampled.

Parasitoid releases varied in frequency, density, and spatial arrangement. In apple orchards, releases were conducted twice in 2022 (15–45 parasitoids per dispenser every third tree), one or two times in 2023 (15–30 parasitoids per dispenser every third tree), and once in 2024 (30 parasitoids per dispenser every fifth tree). In the 2023 pear orchard trial, a single release of 30 parasitoids per dispenser on every fifth tree was conducted to compare plots with flowering strips in the alley versus plots without, alongside untreated controls. Sampling included naturally laid egg masses and beating samples from 25 branches per row to assess parasitism and nymph emergence. In the control plots no parasitized egg masses were found. Fruit quantity and quality were also recorded in the pear trial.

**Long-Term Establishment Monitoring:** To evaluate the establishment and dispersal of *T. cultratus*, all plots were monitored in the years following releases. Starting in May, systematic surveys were conducted across the entire orchard using aspirators in the herb layer, beating samples in the canopy, and collection of naturally laid egg masses. These surveys confirmed the presence of the parasitoid, its ability to survive and establish in the field, and its potential for dispersal. Parasitized egg masses were observed in autumn in plots where the parasitoid had been released, even in areas previously lacking *T. cultratus*, demonstrating successful establishment.

#### **Peripheral Targeted Release Trials (2024–2025)**

Due to economic constraints on mass-rearing of large numbers of *Trissolcus cultratus*, a low density, targeted release strategy was tested in 2024 and 2025. Parasitoids were released only in orchard areas where *P. rufipes* was actively invading, with the goal of establishing the parasitoid to suppress pest population growth. In both trials, releases were conducted at the edge rows, while the inner rows, already infested with the pest, served as a reference for comparison.

In 2024, in one orchard, in each second row two dispensers were placed at the top of the row at the second and 7<sup>th</sup> tree over ten rows. (30 parasitoids per dispenser). For monitoring nymphs and parasitized egg masses the trees 1-15 were assessed as treated plot and the inner trees (trees 16–30) were used as control. In another orchard, 23 dispensers (30 parasitoids each) were placed on every fifth tree along the edge row. Monitoring was conducted in both edge and inner rows in 2024 and 2025 to assess the establishment, spread, and parasitism of the released parasitoids.

## **Results**

### **Efficacy of Inundative and Targeted Releases of *Trissolcus cultratus***

Inundative releases of the native egg parasitoid *T. cultratus* effectively reduced *P. rufipes* populations in heavily infested pome fruit orchards. In 2022 apple trials, releases of 30–45 parasitoids per dispenser twice achieved 88–93% nymph reduction. Single releases in a pear orchard in 2023 reached 82% efficacy, improving to 91% in 2024 with a slightly higher release density. Fruit assessments showed an 18% increase in marketable yield, further enhanced to 26% in plots with flower strips.

Long-term monitoring confirmed that *T. cultratus* established successfully, surviving and reproducing in orchards. The parasitoid was observed in the herb layer during spring/early summer and later in the canopy. Targeted low-density releases at orchard edges in 2024–2025 were effective, with the parasitoid spreading into inner rows, demonstrating that early, strategic releases can reduce pest populations efficiently with rather low number of parasitoids needed.



Figure 1: Percentage of fruit yield in the pear trial categorized by marketability standards in 2024 across three experimental conditions: Control, *Trissolcus* release, and *Trissolcus* release in 2023 combined with flower strips.

## Discussion

The inundative release of *Trissolcus cultratus* effectively reduced *P. rufipes* populations (88–93% nymph reduction in 2022, 91% in 2024) and increased marketable yield, especially with flower strips (Al Karrat et al., 2020, 2022). The parasitoid established, reproduced, and dispersed from release points, showing that targeted, low-density releases can be an important tool in cost-effective pest control. Further research is needed to better understand its field behaviour and optimize integration with habitat management.

## Acknowledgements

The research was funded by Deutsche Bundesstiftung Umwelt (Az 37933).

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