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Apple and pear weevils: biological findings and insights for their control

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Abstract

Controlling apple and pear weevils has become crucial in organic orchards in France due to the extent of the observed damage. Knowledge of the biology of these two insects is limited, which hinders the development of alternative control methods. This study provides new insights into the biology of the pear blossom weevil and evaluates the effectiveness of a mass trapping method for the apple blossom weevil. Under Mediterranean conditions, adult pear blossom weevil emergence appears to be temporally restricted, suggesting an optimal period for targeted control. Leaf puncture damage is described for the first time, and detailed observations of bud damage are reported to aid field identification. For the apple weevil, 175 traps were installed on each trunk in April 2024 over an area of 820 m². In 2025, the percentage of damaged flowers decreased significantly by 63% in the treatment using traps. The captures of non-target organisms were also recorded.

Keywords: *Anthonomus pomorum*, *Anthonomus pyri*, mass trapping, feeding punctures, unintentional catches

Introduction

Apple weevil (*Anthonomus pomorum*) and pear weevil (*Anthonomus pyri*) are serious pests, particularly affecting organic production. Developing effective pest control strategies, especially alternative methods based on trapping, requires a thorough understanding of both species' biology. However, as the behaviour of apple and pear weevils has only been described in a few contexts, it remains difficult to extrapolate these observations to design appropriate prophylactic measures.

In this study, regarding pear weevil, we described the timing of its biological stages and documented bud punctures and feeding damage. Regarding apple weevil, we assessed the efficacy of a mass trapping method developed by Brouwer and Helsen (de Bruine, 2023; Helsen, 2025) on apple weevil damage over two consecutive years in an organic apple orchard.

Material and Methods

Pear weevil trial

Sampling was conducted in a pear orchard located at Noves (Vaucluse, France) on the cultivars Williams, Comice d'hiver, and Red Satin. From November 2023 to January 2024, 15 adults were captured by shoot threshing and stored in plastic pots covered with insect-proof nets containing pear tree shoots with uninfected buds. Weekly, pear shoots were replaced with fresh ones. Pots were maintained at outdoor temperature. In May 2024, 50 adult pear weevils were placed in outdoor insect-proof cages containing potted pear trees (Williams Rouge) to study the damage caused by adults.

In 2024, 50 buds were sampled from five pear trees, whereas in 2025 the same number of buds was collected from ten pear trees. Sampling was conducted every two weeks from

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January to April to characterize development from egg to adult. In addition, 150 buds in 2024 and 500 buds in 2025 were stored in two separate plastic bottles, each containing Eppendorf tubes, and maintained at outdoor temperature to study adult emergence (Figure 1a).

Apple weevil trial

The mass trapping trial was conducted in a commercial organic apple orchard located at Peyrins (Drôme, France). The Dalinette cultivar was planted in 2011 at a spacing of 4 m × 1.25 m. The total area of the orchard is 2.465 m². A natural wooded area lies 25 m north of the orchard. Tree rows are covered with insect-proof nets (5.5 mm × 2.2 mm) from fruit set to harvest to control codling moth.

Apple weevil traps consisted of bundles of hollow tying tubes (Triangle-Outillage; ref: 851155; inner diameter 3.5–4.0 mm). Bundles were composed of 10 or 20 tubes of 16 cm length (Figure 1b). The east part of the orchard was equipped with one trap per tree, positioned at 50 cm height on the trunk. This modality is called “Mass trapping”. Mean trunk diameter was 7 cm (range: 3–13 cm). The traps were installed on 12 April 2024 on 175 trees (7 rows × 25 trees), representing a density of 60.000 tubes per hectare and covering 820 m². On the west side, no traps were installed. This modality is called “Reference”.

In 2024 no insecticides were applied in the plot. In 2025 an insecticide (Success 4, 0.2 L/ha, containing 480 g/L spinosad) was applied on 14 March over the whole plot to control apple weevil damages. The traps were collected on 17 December 2024 and 7 January 2025, and stored at –20°C for at least 50 days before counting apple weevils and non-target captures. In the “Mass trapping” and “Reference” modalities, the Apple weevil damages on flowers were observed on 12 April 2024 (before setting the traps, so it is the initial condition) and on 18 April 2025 (to assess the efficacy of the traps).

Figure 1: From left to right: pear weevil larvae observed in a bud (red line is 1mm length); bottles used for assessing emergence of pear weevils; bundle of tying tubes used for mass trapping on an apple tree trunk.

Results

Pear weevil trial

The developmental stages of pear weevil, from egg to adult, were monitored in buds in 2024 and 2025. Dynamics were similar across years (Figure 2). First larvae appeared at the end of January and predominated in buds during February and March. First pupae appeared at the end of March. First emergence holes were observed on 9 April 2024 and on 8 April 2025, corresponding to BBCH 69 stage (all petals are fallen). In both years, 70% of adult emergence occurred from 15 April to 29 April. In another sample observed in the same area and weather conditions in 2024 and 2025 (data not shown), adult emergence spanned from 9 April to 9 May.

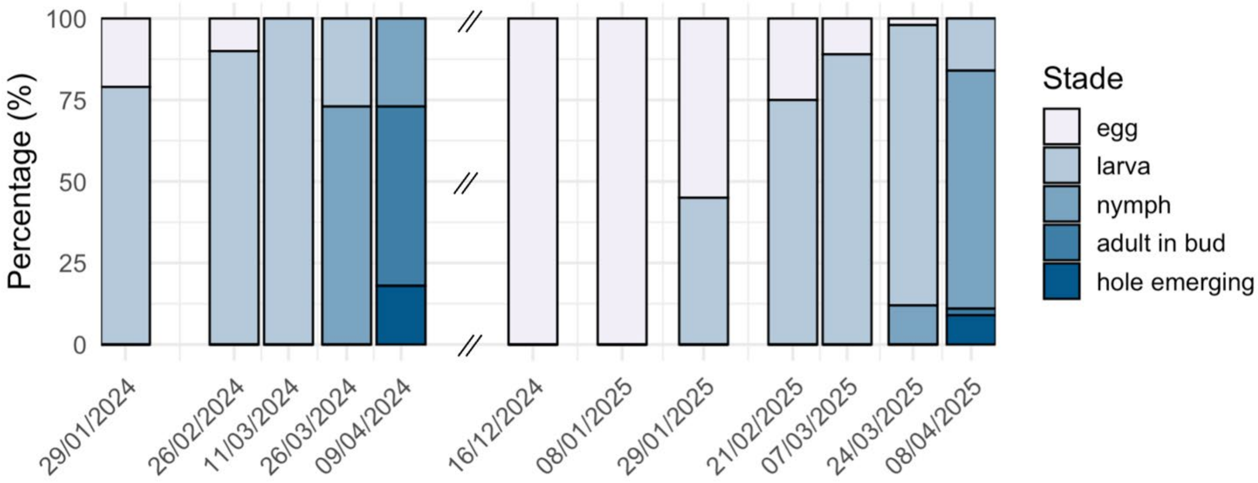

Figure 2: Evolution of the proportion of the stages of development of pear weevil observed in buds in 2024 and 2025.

Egg-laying punctures were mainly observed on the upper half of flower buds (Figure 3A). These punctures are filled, making them difficult to see (Figure 3B). Larvae hatched in January and developed inside the bud. Furthermore, adults made punctures in some buds without laying eggs, likely for feeding. These feeding punctures are <0.5 mm in diameter, mostly in the lower half of the bud at the insertion of two scales, and remain unfilled.

In spring 2024, we observed a previously unknown behaviour: after emerging, adults inserted their rostrum deep into the base or middle of the leaf petiole (Figure 3C). These feeding punctures caused leaf necrosis and bud mortality. In insect-proof cages, up to 10% of leaves were necrotic.

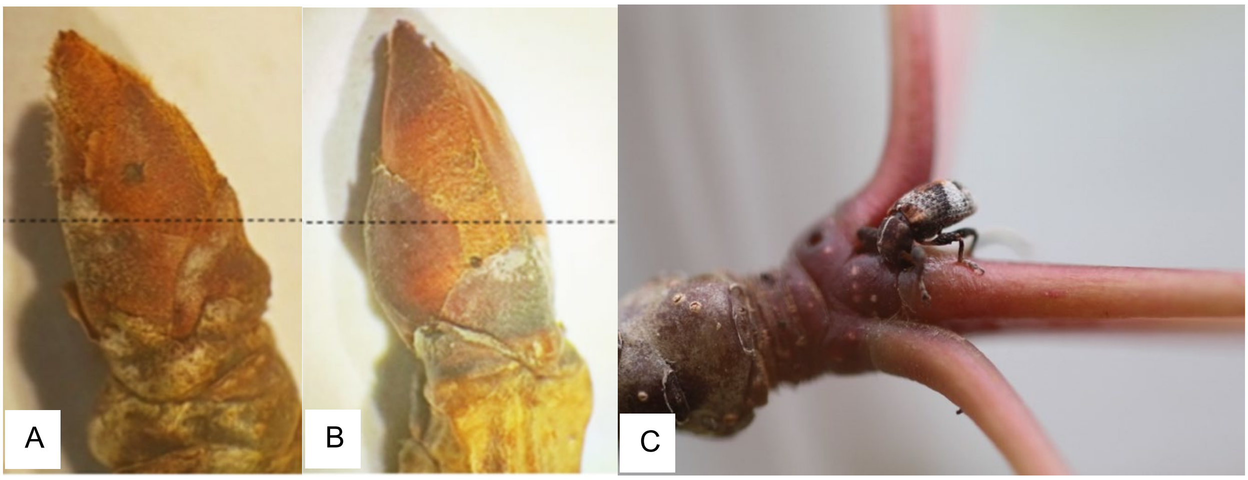

Figure 3: Pear buds showing egg-laying punctures in the upper part (A) and punctures associated to feeding behaviour at the insertion of scales (B). The dotted line indicates the middle of the bud. Pear weevil boring a hole at the base of a leaf stalk, subsequently causing its necrosis (C).

Apple weevil trial

In 2025, flower damage by apple weevils was significantly reduced in the mass trapping treatment (ANOVA, $p < 0.05$). In the control and trap treatments, 22.7% and 8.3% of flowers were damaged, respectively, meaning a 63% reduction in damage (Figure 4A). Mean catches in traps with 10 and 20 tubes were 5.7 and 10.6 apple weevils, respectively. Among

1,500 trapped weevils, 578 beneficial insects or spiders (earwigs, spiders, predatory bugs, hoverflies, lacewings, ladybugs) and 955 non-beneficial insects (aphids, molluscs, Diptera, Curculionidae, Coleoptera, others) were also captured (figure 4B).

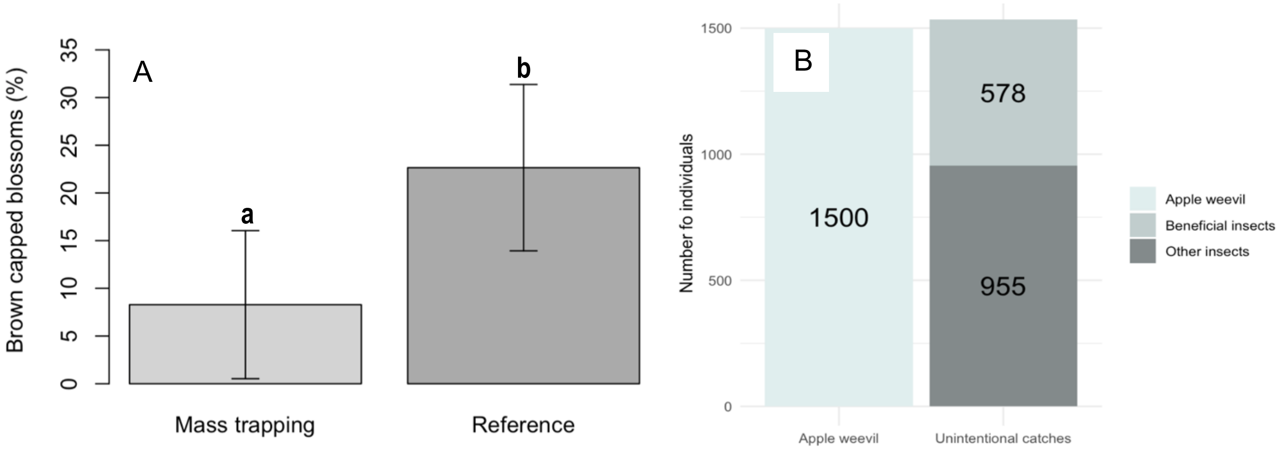

Figure 4: Percentage of brown capped blossoms observed on 18 April 2025 in the “Mass trapping” and the “Reference” modalities (ANOVA test, p<0,05) (A); number of apple weevils and non-target individuals cached in the 175 traps (B).

Discussion

Pear weevil

Over two years, we observed that in Mediterranean conditions, 70% of adult pear weevil emergence occurs within two weeks. Compared to what has been described in the literature in France before, the beginning of pear weevil emergence in this study was observed earlier and was more limited in time. Because pear weevils are feeding just after emergence, this relatively short period could be an optimal timing for a targeted control. The leaf petiole damage by adults we observed has not been previously reported. Descriptions of egg-laying and feeding punctures provide initial tools for field identification.

Apple weevil

This study demonstrates that the mass trapping method developed by Brouwer and Helsen can be successfully applied in an organic adult apple orchard under sub-Mediterranean conditions, maintaining similar efficacy as reported in the Netherlands. Quantification of non-target catches highlights potential drawbacks that require further investigation to minimize undesirable effects.

Acknowledgements

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