# Mass trapping of the apple sawfly *Hoplocampa testudinea*

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## Abstract

*The apple sawfly* Hoplocampa testidunea *Klug (ASF) is a key pest of apple. It is of special importance in organic and low-input apple production as non-chemical control options are limited. Adult ASF can be trapped with white sticky traps. The white colour of these traps must resemble the colour of the apple flower petals, with hardly any reflectance of UV. We explored the use of such traps as a mass trapping device. Here we present the preliminary results. In a comparison of different trap types, disposable polypropylene plates caught the highest numbers of ASF. Applied at a density of 555 or 1111 traps per ha, decrease of ASF infestation was not significant. The total ASF numbers caught on the traps indicate that an even higher trap density could increase the efficacy of the technique. Feasibility of a mass trapping technique will depend on its efficacy, but also on the availability of a trap that is cheap, easy to apply and degradable or suitable for re-use.*


**Keywords:** Apple sawfly, mass trapping

## Introduction

The apple sawfly *Hoplocampa testidunea* Klug (ASF) is a pest of apple in the temperate regions of Europe and Eastern North America (Vincent *et al*., 2019). ASF is of special importance in organic and low-input apple production, as non-chemical control options are limited. After conversion to organic fruit production the population builds up over years. Infestation can cause losses up to 80% of the harvest. In conventional apple growing, ASF is commonly controlled by insecticide application shortly after bloom, but reduced availability of pesticides and the wish to reduce pesticide use stimulates the search for non-chemical alternatives. Botanical insecticides have a good effect on hatching larvae, but are difficult to register under European legislation. The botanical *Quassia amara* is allowed in organic production (EG Regulation Nr. 1907/2006 and its amendment EU Regulation 2015/830), but only when it is registered in Europe and in the specific country. In the Netherlands it is not registered.

Owens and Prokopy (1978) were the first to show that adult ASF can be trapped with white sticky traps. Comparing captures on traps painted with different types of white, they found the highest captures on surfaces painted with zinc-white. The reflectance pattern of the zinc-white traps strongly resembles that of the apple flower petals, i.e. a white colour with hardly any reflectance of UV. Haalboom (1983) showed that ASF damage was lower on trees near zinc-white traps but concluded at the time that mass trapping would be too expensive as a management method. Inspired by an Austrian colleague we started mass-trapping in 2016 on a one ha field at the Biodynamic orchard 'de Muyehof'. In 2018 we started experiments in order to select the most suitable trap types and materials for mass trapping, and to evaluate the effect of mass trapping on ASF infestation at different trap densities. In this paper we present the preliminary results of this work.

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## Material and methods

*Selection of suitable materials and trap type.* The experiment was carried out in an organic orchard with apple cv. Santana. Table 1 shows the trap types tested. Traps of treatment A-D consisted of a 20 x 15 cm rectangular surface, attached on a plywood board of the same size. Traps were attached to the tree poles at 1.80 m high. Treatment E consisted of a round disposable white polypropylene plate, that was attached on a horizontal wooden strip, without using the plywood board. Insect glue (Soveurode Spezialleim, Witasek, AT) was sprayed on one side of traps. Traps were installed well before the start of flowering, and removed after flowering. Catches per trap of ASF and the main groups of predators, parasitoids and pollinators were registered. The trial had a randomised complete block design with 10 replicates.

Table 1: Trap types and materials used in trap comparison experiment, 2018.

| | Treatment | Material |
|---|---|---|
| A | Rebell Bianco | One wing of the commercial trap (Agroscope, CH), attached on plywood 20x15 cm. |
| B | Zinc white | Plywood painted with Talens Amsterdam All Acrylics 104 Zinc White |
| C | Titanium white | Plywood painted with Talens Amsterdam All Acrylics 105 Titanium White |
| D | Disposable plate square | Material of treatment E, but cut square and attached on plywood 20x15 cm |
| E | Disposable plate round | Original round polypropylene plate (Pro Pac, DE) same surface as A-C |

Figure 1. Round plate (treatment E) and the same material attached on a rectangular board (treatment D). Both traps have the same surface (300 $cm^2$).

*Effect of mass trapping on ASF infestation levels.* The experiment was carried out in an organic orchard with apple cv. Topaz and Santana. Different densities of round disposable plates (as treatment E above) were deployed in plots of approximately 1000 $m^2$. Treatments were: 1) no traps; 2) 555 traps per ha (one trap every six meter in a row) and 3) 1111 traps per ha (one trap every 3 meter in a row). Traps were attached to the tree poles at 1.6-1.8 m high, alternately facing south or west. Insect glue was sprayed on one side of the plates one week before bloom. Just after bloom ASF damage was quantified by counting the number of flowers with oviposition marks. One month later, the number of fruits with ASF larval tunnels was counted. The trial had a randomised complete block design with 5 replicates.

## Results and discussion

*On-farm experiences.* Mass-trapping was started in 2016 on a one ha block of full grown Santana apple trees where until then yearly spraying against ASF was necessary, based on a threshold of 5 eggs per 100 flower clusters, counted at petal fall. We used 250 disposable plastic plates per ha (table 2). Plates were attached to support poles at about 1,6 m high, alternately facing four different directions. ASF catch was registered per trap, giving us an insight in the spatial distribution. This revealed that one half of the orchard had consistently higher numbers of ASF.

Table 2. Number of ASF on traps during the on-farm application of mass trapping.

| | 2016 | 2018 | 2019 |
|---|---|---|---|
| Traps / ha | 250 | 250 | 500 |
| Mean number ASF / trap | 7.5 | 1.1 | 3 |
| Total number ASF trapped | 1423 | 203 | 1197 |

Despite the mass trapping, we counted 15 eggs/100 clusters in the highly infested part of the orchard in 2016. In the other half we counted 4 eggs/100 clusters. A spray treatment was carried out in the highly infested half. In 2017 we had a severe frost during bloom which resulted in hardly any fruit below 1,8 m. In this year we did no counting and no control treatments. Harvest was about 50% of the normal crop load, without noticeable damage by ASF. Had the sawfly also been hit by the frost? In 2018 we applied mass trapping again, and we registered a small number of ASF on the traps and almost no infestation on the fruits was found. No treatment followed. In 2019 we doubled the trap density, based on the results of the 2018 trials (see below). Total trap catches were similar as in 2016. With a mean 3,5 eggs/ 100 clusters we decided to skip treatment again. We had a full crop and found only a few infested fruits.

*Comparison of different materials for trapping.* Trap types A, C and D caught similar numbers of ASF (table 3). Surprisingly, the zinc white paint (type B) attracted very few ASF. Measurement of reflection spectra (data not presented here) revealed that the type B trap reflected more UV-light (340 – 400 nM) than the other trap types tested. This confirms the previous finding of Owens and Prokopy (1978) that low reflection of UV light is important for ASF attraction. The free-hanging round plates caught significantly more sawflies than the other traps. A possible explanation is that the white colour of these plates is brighter because the material is semi-transparent, and is therefore better visible for ASF than other traps with a similar colour, especially on sunny days. The round plates had relatively low numbers of undesired bycatches, but variation between traps was high and differences were not significant.

Table 3. Average number of apple sawflies and parasitic wasps per trap (n=10) in 2018.

| | Treatment | Apple sawfly | Parasitic wasps |
|---|---|---|---|
| A | Rebell Bianco | 7,9 b* | 9,2 a |
| B | Zinc white | 0,5 a | 12,5 a |
| C | Titanium white | 8,8 b | 10,9 a |
| D | Disposable plate square | 8,2 b | 12,7 a |
| E | Disposable plate round | 13,7c | 3,6 a |

**Different letters indicate significant differences between averages (p<0.05).*

*Effect of mass trapping on ASF infestation levels.*

Average ASF infestation level was lowest in the fields with the highest trap density, but differences were not significant (figure 2). Infestation levels were low and variation within the experimental field was high. For mass trapping to be effective, a major part of the ASF adults should be trapped shortly after emergence from the soil, before the females lay their eggs in the open flowers. But in our experiment, the highest numbers of ASF adults were trapped after bloom. The ASF flight period varies between years, compared to the flowering time of

apple, and in some years a significant part of the flight takes place before full bloom of apple. One might expect that in years with an early flight, relative to the time of flowering, the effect of mass trapping will be higher.
The average number of ASF per trap was the same at the two trap densities tested. This indicates that sawflies are attracted to the traps over a short distance only and that an even higher trap density could increase the efficacy of the technique.
In our experiments, disposable polypropylene plates trapped the highest ASF numbers. Obviously, we are looking for materials that are cheap, easy to apply and degradable or suitable for re-use. In 2018 we tested two types of biodegradable plates which unfortunately failed to attract any ASF.

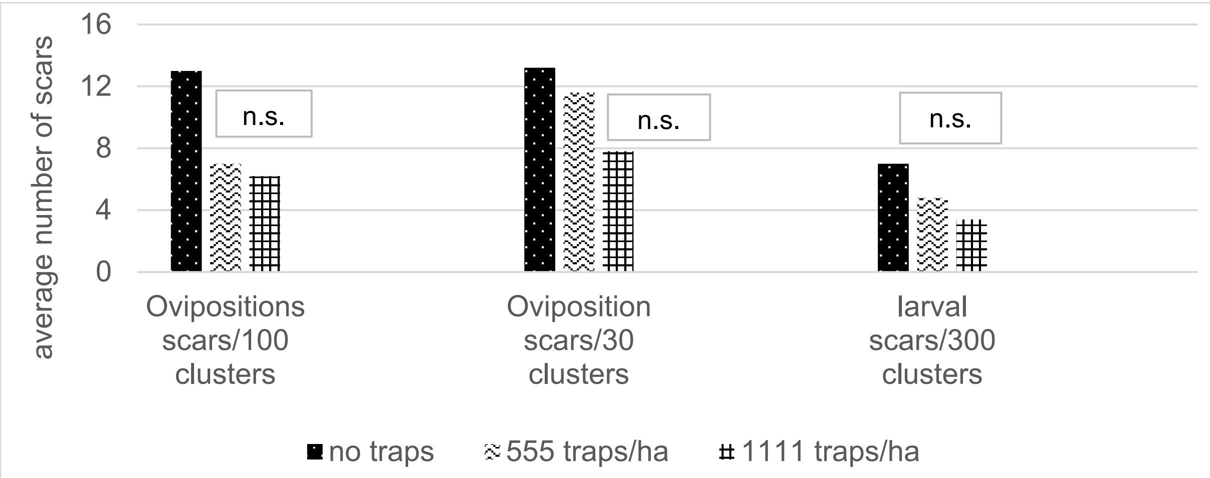


Figure 2. Number of oviposition scars per 100 flower clusters on 2 May, per 30 flower clusters on young shoots on 3 May, and number of fruits damaged by larvae on 29 May at in plots with different trap densities (no, 555/ha, 1111/ha). N=5, differences are not significant (p<0.05 level).

**Acknowledgements**
We thank the collaborating fruit growers. Experiments were financed by the Dutch Ministry of Agriculture, Nature and Food Quality, research programme 'Kennisimpuls Groene Gewasbescherming'.

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