Investigations on biology and behavior of *Halyomorpha halys* (Heteroptera: Pentatomidae) aimed at its sustainable management in agro-ecosystems



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Doctorate in Agri-Food Science, Techologies and Bio-Technologies

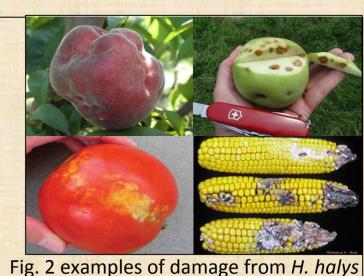
XXXIII cycle, 1° year

Introduction

Halyomorpha halys (Heteroptera, Pentatomidae) (Fig. 1), native to East Asia, is a polyphagous species with more than 300 host plants recognized. Thanks to its close association with manmade structures during the overwinter period, that facilitates human assisted spread, this insect is a fast spreading invasive pest of fruit orchards and many other crops both in the U.S.A., in Italy and other European countries



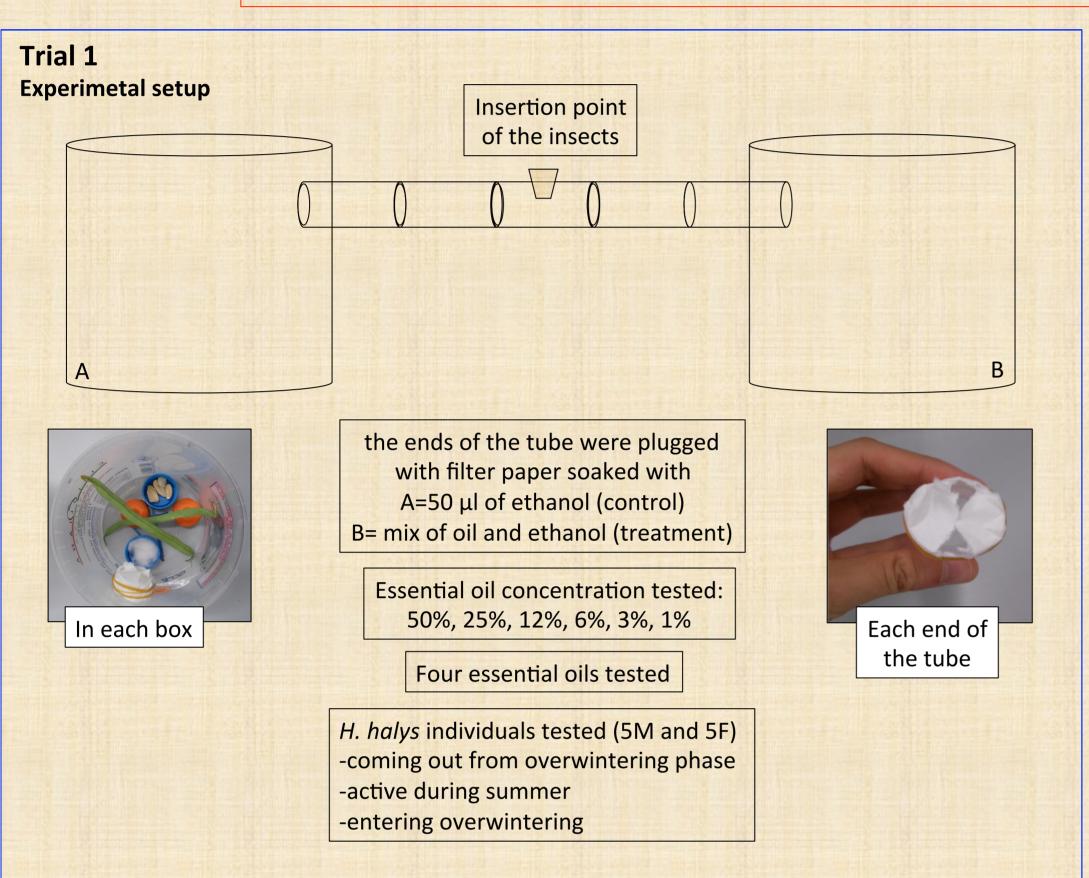
Using its piercing-sucking apparatus on plants tissues, particulary of fruits and seeds, *H. halys* can cause deformities, suberification, discoloration, necrotic areas and watery rot, that render products unmarketable (Fig. 2). To manage the invasion of this pest, farmers have increased the use of broad spectrum insecticides, resulting in disruption of the most Innovative IPM strategies, with serious risks for both the economy and the environment. In particular, the massive use of these insecticides can lead to the reduction of beneficial insects, such as pollinators, parasitoids and predators, altering balance in agroecosystems. Therefore, it is necessary to identify more sustainable strategies to manage this pest.



Aim

The project is focused on the sustainable management of the invasive alien species H. halys. Specifically, the work was divided into different trials:

- 1. Repellency test: The repellency of essential oils in comparison with the attractiveness of the food on starving individuals was tested.
- 2. Predatory test: The predatory ability of solitary generalist predators was tested on eggs and the first two instars of the H.halys.
- 3. Predatory sampling and gut content analysis: Predators were field-sampled in the Reggio Emilia urban parks and their gut content will be analysed.
- 4. Predatory test with social insects: The predatory ability of the ant species Lasius niger on the eggs and all the juvenile stages of H. halys will be test.



Protocol

After a 24h period of fasting, the adults were inserted individually into the tube. A check was performed after 1h, after 6h and after 24h, observing in which direction the individuals were directed.

Four urban parks of the city of Reggio Emilia were selected with an area of at least 500 square meters,

close (30-50 m) to a water source and close to an agro-ecosystem.

Protocol

Trial 3

In these urban parks, 20 attractive trees for *H. halys* were selected. On each tree a tree-beating session (Fig. 3) was performed using a stick and a tray. In the four urban parks there was also a sweep net session (Fig.4) consisting of 10 shots in 5 points characterized by

a sweep net session (Fig.4) consisting of 10 shots in 5 points characterized by tall grass. The potential predators were collected in falcon vials, then transferred in the freezer at -20°C. Sampling was performed in each park every 15 days from the beginning of

In the next months the gut content of the collected predators will be analysed using molecular techniques to see if they had preyed on *H. halys*.

May to the beginning of October.

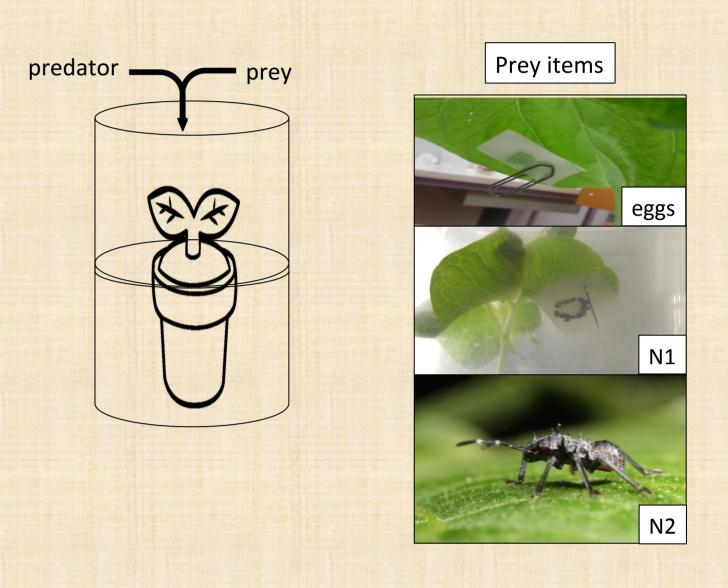


Fig. 3 a tree-beating session Fig. 4 a sweep net session

Trial 2 Experimental setup

Protocol

After a starving period of 24h, each predator was individually placed inside a transparent box with the *H. halys* prey item. For each replicate, a control was carried out, with the same set up but without the presence of the predator. After 48 hours the survival of the prey items and the predators was recorded.



Predators tested:

Adalia bipunctata (Coleoptera, Coccinellidae) adult
Anthocoris nemoralis (Rhyncota, Anthocoridae)
adults and larvae of Cryptolaemus montrouzieri (Coleoptera, Coccinellidae)
Chrysoperla carnea (Neuroptera, Chrysopidae) larvae
Forficula auricularia (Dermaptera, Forficulidae)
Harmonia axyridis (Coleoptera, Coccinellidae) adult
two species of the Himacerus genus (Rhyncota, Nabidae)
Nagusta goedelii (Rhyncota, Reduviidae)
Pholidoptera littoralis (Orthoptera, Tettigonidae)
Rhynocoris iracundus (Rhyncota, Reduviidae)

Trial 4 Experimental setup eggs N1 N2 N3 N4 N5

Protocol

At the beginning it will be allowed to ants to reach the plant. On the plant, a small sheet of aluminum with drops of honey will be placed, so that the ants recognize the plant as a source of food. After 24h the aluminum sheet will be removed. After 24h on the plant, an eggmass or 6 individuals for each nymphal stage will be placed. A check will be performed after 2h, 6h, 24h and 48h, recording the number of dead preys. For each replicate, a control will be carried out, with the same set up but without the presence of the ants.

First results –Trial 2

From the comparison between the survivors of the treatment group (prey and predator) and the control one (no predators) it emerged that: *Pholidoptera littoralis* is the only predator capable of predating all the instars tested, including eggs.

N. goedelii, C. carnea larvae and nabids from Himacerus genus significantly predated the first instars

R. iracundus and nabids of the Himacerus genus significantly preyed on second instars.

R. iracundus significantly predated also adult individuals of H. halys.

