How to distinguish the eggs of *Halyomorpha halys* Stål, *Nezara viridula* L., and *Pentatoma rufipes* L.

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Abstract

Stink bugs include several species, which have been generally classified as important pests of many fruit crops worldwide causing serious fruit damage and economic loss. Among the most dangerous species of stink bugs found in organic apple orchards at the Lake of Constance is Pentatoma rufipes *L., and recently also* Halyomorpha halys *Stål. The southern green shield bug,* Nezara viridula *L., has not been found until now in organic apple orchards, although it may occur in the future. Here we describe the size, shape, chorion, and colour of the eggs of these species to facilitate the easy in the field.*

Keywords: shield bugs, egg morphology, description, field guide.

Introduction

Stink bugs are important pests of apple and pear worldwide, causing severe economically important loss (Rice et al. 2014). In orchards, the bugs feed on buds, flowers, leaves and fruits, resulting in discoloured spots, distinct tissue depressions, deformed fruits, and reduction of yield (Kehrli & Pasquier 2012, Peusens & Beliën 2012). In organic orchards in Germany, until now, *P. rufipes* caused considerable loss in pear (Koenig 2014) and in 2019, reported for the first time, also in several apple varieties (Alkarrat et al. 2020).

Many studies have focused on immature and nymphal stages of stink bugs, while there are only few studies that concentrate on the egg stage (Yonke 1991, Bundy & McPherson 2000, Grazia et al. 2008). Eggs of stink bugs are vary in their morphology and hence can be easily recognized by their characteristic shape and variable degree of chorion ornamentation (Hinton 1981, Yonke 1991).

In this study, we investigated the variation in egg morphological characters of three important stink bugs (*Halyomorpha halys* Stål, *Nezara viridula* L. and *Pentatoma rufipes* L.).

H. halys Eggs

The eggs of the brown marmorated stink bug are of light green or light blue colour when they are freshly deposited, but become gradually darker with ageing. The egg are *ca.* 1 mm in diameter and of elliptical in shape. Adult deposit their eggs in clutches of 20 - 30 eggs, usually on the under sides of host plkant leaves (Hoebeke & Carter 2003, Nielsen et al. 2008).

As the embryo develops, it becomes visible through the egg chorion, with the eyes appearing as two separate small red spots. T-shaped, blackish egg bursters are visible in this stage, but the empty, transparent egg showing them more clearly. Parasitized eggs are black in colour, with no eyes visible, neither of the parasite nor the bug nymph.

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N. viridula eggs

N. viridula females oviposit in clusters of 60 to 90 eggs (Musolin & Numata 2003, Musolin et al. 2007). Freshly deposited eggs are long shaped and of cream colour, darkening slightly 16-24 h after deposition.

The female fixes the egg on the host plants and between them as well by an adhesive material, forming a compact egg cluster leaving no spaces between the eggs.

The eyes of the embryo are red in colour and become visible through the operculum as two red spots, after which a red T-shape appears between them. After 5- 6 days the eggs show a small blackish burster. Empty eggs are not transparent.

Parasitized eggs turn black after 3-4 days, not showing eyes of the embryo of the parasitoid.

P. rufipes eggs

Egg of the forest bug is neon green in colour, spherical in shape, and with > 1 mm diameter, of bigger size than the eggs of *H. halys*. Females of *P. rufipes* lay eggs in clusters of 8 - 18 eggs on the underside of the host plant leaves.

The colour of the eggs become also gradually darker, and the eyes of the ageing embryo appear as two red spots. Then dark brown burster become visible. The empty eggs are transparent and the burster is clear but smaller than the burster on *H. halys* eggs.

In parasitized eggs the eyes of the parasitoid will become visible as two orange-coloured spots. After 10 days, the eyes disappear and the eggs become fully black.

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