

## A brief look to the morphology of the Malpighian tubules in *Halyomorpha halys* (Stål, 1855) (Hemiptera: Heteroptera, Pentatomidae)

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**ABSTRACT:** *Halyomorpha halys* Stål (Hemiptera: Pentatomidae) is a widespread and very harmful species to many different plant species and can cause lead to great economic damage. The excretory system of *H. halys* is composed of four Malpighian tubules. Each Malpighian tubule is divided to region according to the external structures: proximal and distal regions.

**KEYWORDS:** Excretory system, Malpighian tubules, *Halyomorpha halys*, insect, granules

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*Halyomorpha halys* Stål (Hemiptera: Pentatomidae) (syn. *H. mista*) is an invasive species which spreads almost all over the world such as Asia, America, Europe, and Oceania.

The reason why this species can spread four continents is that they are strong flier according to many references.

The individuals belong to this species are polyphagous species and they feed on more than 300 plant species generally from Fabaceae and Rosaceae families (Hoffman 1931; Lee et al. 2013; Bariselli et al., 2016; Bergmann et al. 2016; Horwood et al., 2019).

*H. halys* individuals can cause great damages to many plants such as orchard crops, grapes, row crops, vegetables, ornamentals, etc. by wilting and reduced yield and this can lead to major economic consequences.

Besides, they can cause another damage, such as to the buildings by overwintering inside them.

Considering these reasons, we can say *H. halys* individuals poses a great biosecurity risk (Watanabe et al. 1994; Nielsen et al. 2008; Toyama et al., 2011; Zhu et al., 2012; Rice et al. 2014; Kriticos et al., 2017; Horwood et al., 2019).

The Malpighian tubules are the organs of the excretory system in insects. They are attached to the alimentary canal and the gut lumen and the Malpighian tubule lumen are connected together.

Their morphological characters, numbers, and histological features can vary in different insect groups.

The aim of this study is to give a short brief about the morphological features of the Malpighian tubules in *H. halys*.

For this purpose, the stereomicroscope and scanning electron microscope techniques were used in Gazi University Prof. Dr. Zekiye Suludere Electron Microscope Center.

*H. halys* individuals have four Malpighian tubules.

These tubules are connected to the alimentary canal.

The connection point of the Malpighian tubules to the alimentary canal is pylorus region.

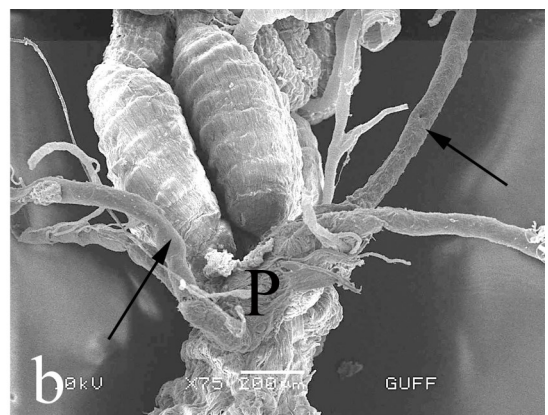
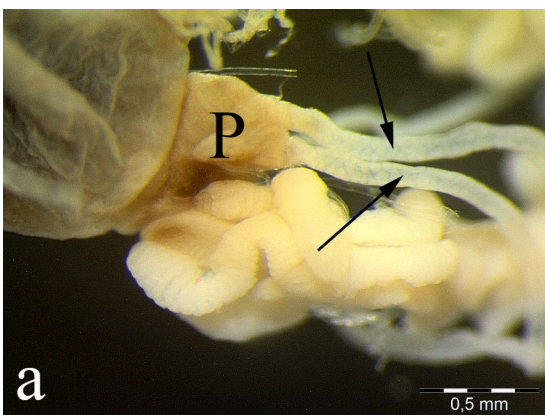
Each Malpighian tubule have two morphologically different regions as the proximal side and the distal side.

The proximal side is closed to the alimentary canal and its external appearance looks tubular and smooth.

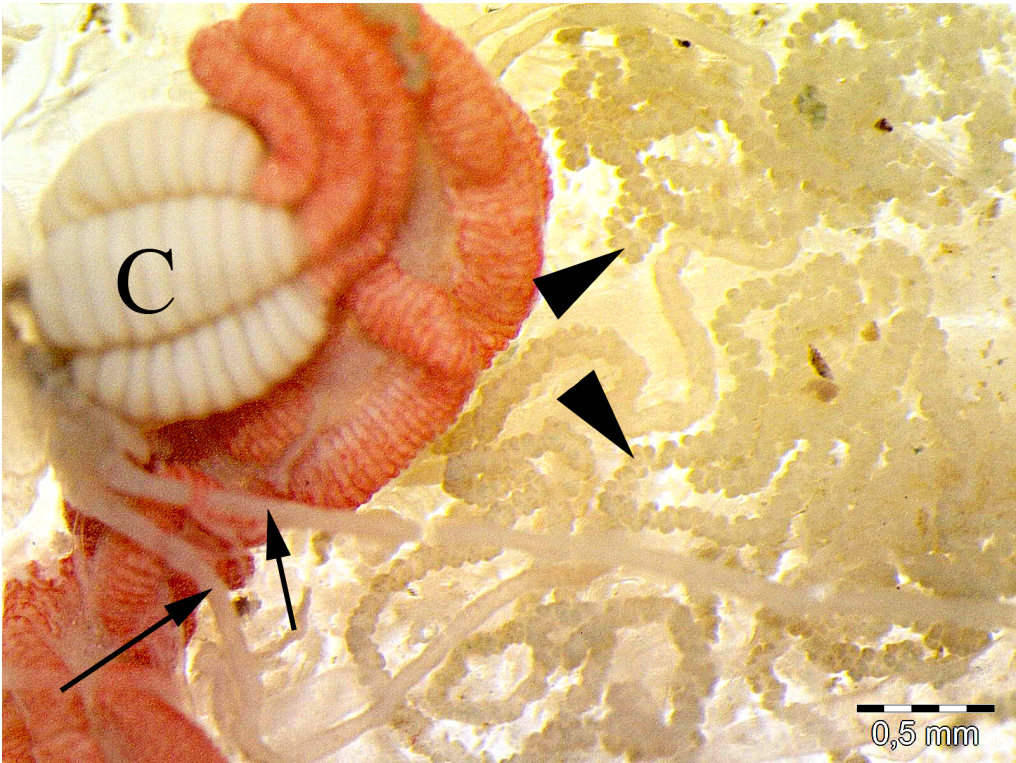
On the contrary, the distal region appears gnarled.

The lumen of the distal Malpighian tubule is narrow while the one of proximal Malpighian tubule is larger.

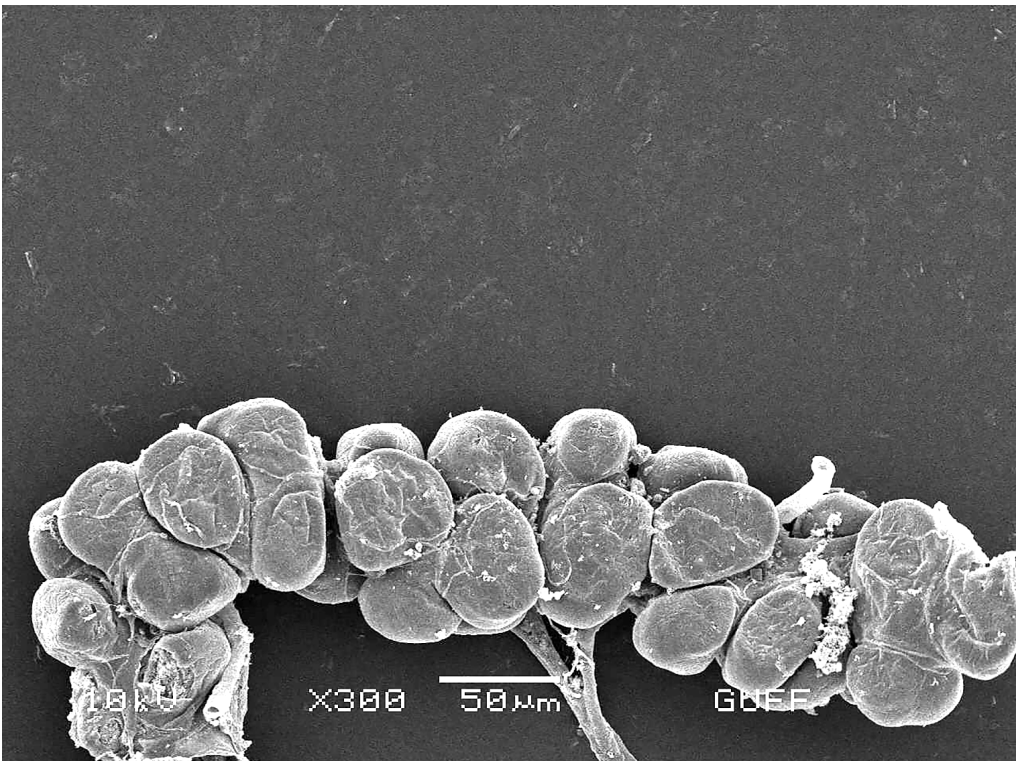
Besides the distal side of the Malpighian tubule has numerous granules of different diameters in its lumen.



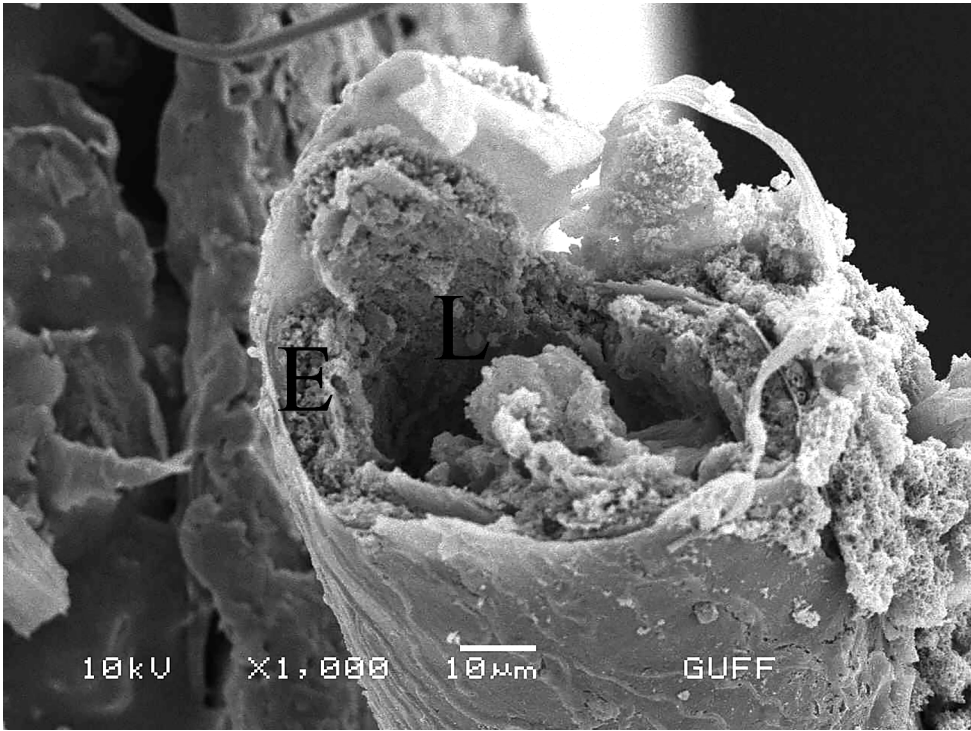
**Figure 1.** Four Malpighian tubules connected to the pylorus region of the alimentary canal. a. Stereomicroscope image (Scale bar=0,5 mm), b. SEM image (Scale bar=200 μm). P: pylorus, arrows: the proximal regions of the Malpighian tubules.



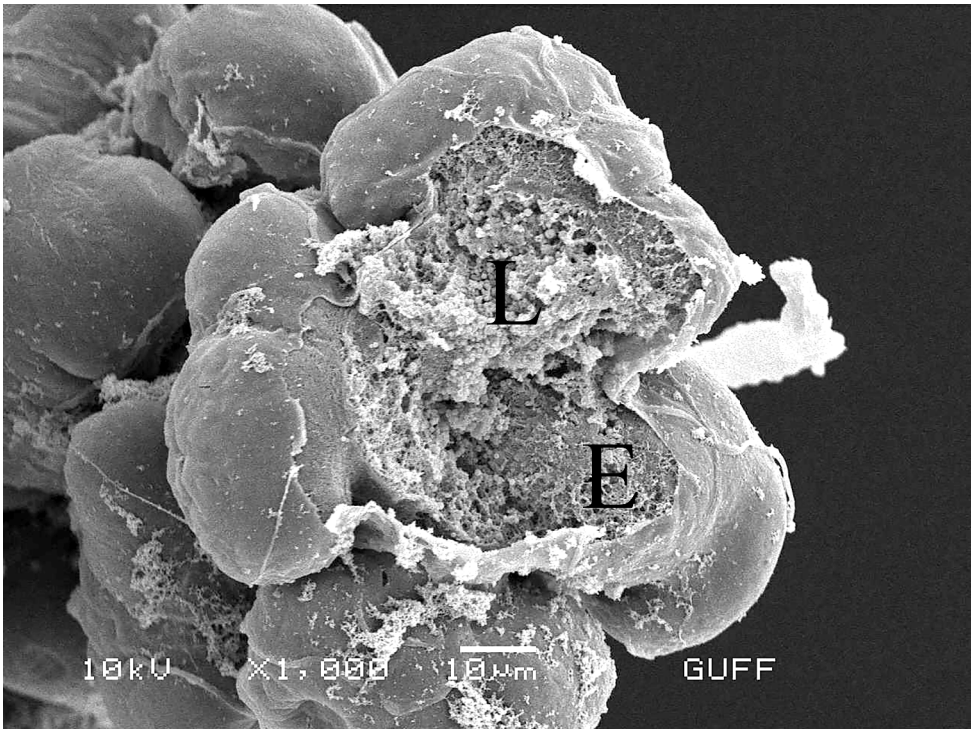
**Figure 2.** Stereomicroscope image of the proximal (arrows) and distal (arrowheads) regions of the Malpighian tubules connected to the alimentary canal (Scale bar=0,5 mm).



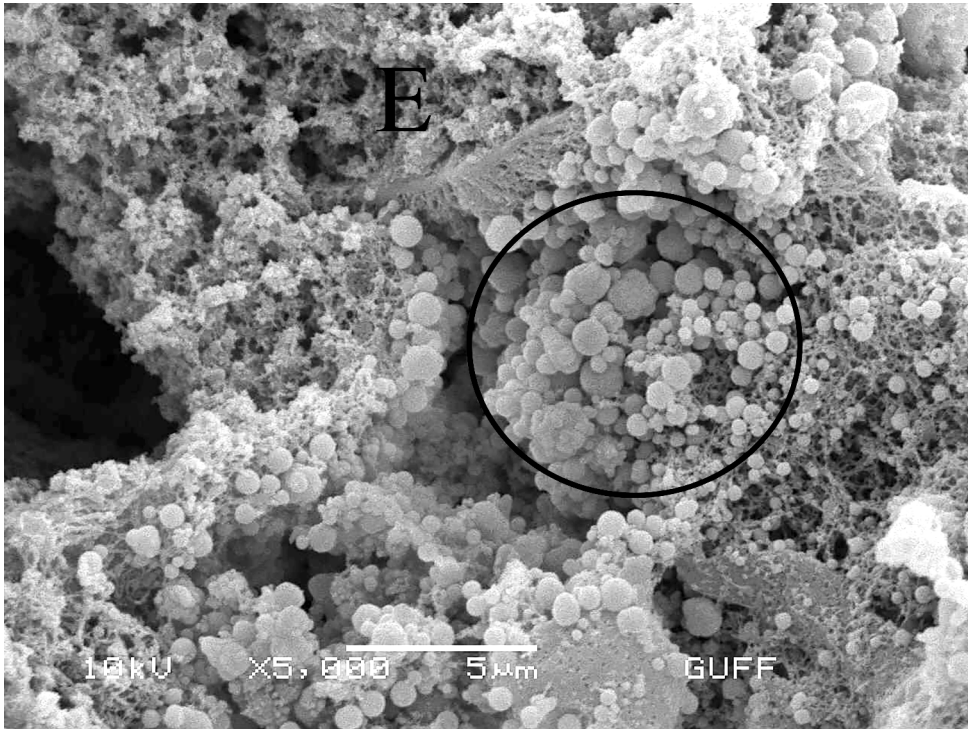
**Figure 3.** The SEM image of the external side of the distal Malpighian tubule (Scale bar=50 μm).



**Figure 4.** The cross section of the proximal region of the Malpighian tubule. (SEM image, Scale bar=10 µm). E: epithelial layer, L: lumen.



**Figure 5.** The cross section of the distal region of the Malpighian tubule. (SEM image, Scale bar=10 µm). E: epithelial layer, L: lumen.



**Figure 6.** The epithelial layer (E) and the granules (encircled) in the lumen of distal region of the Malpighian tubule. The cross section of the proximal region of the Malpighian tubule. (SEM image, Scale bar=5  $\mu$ m).

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