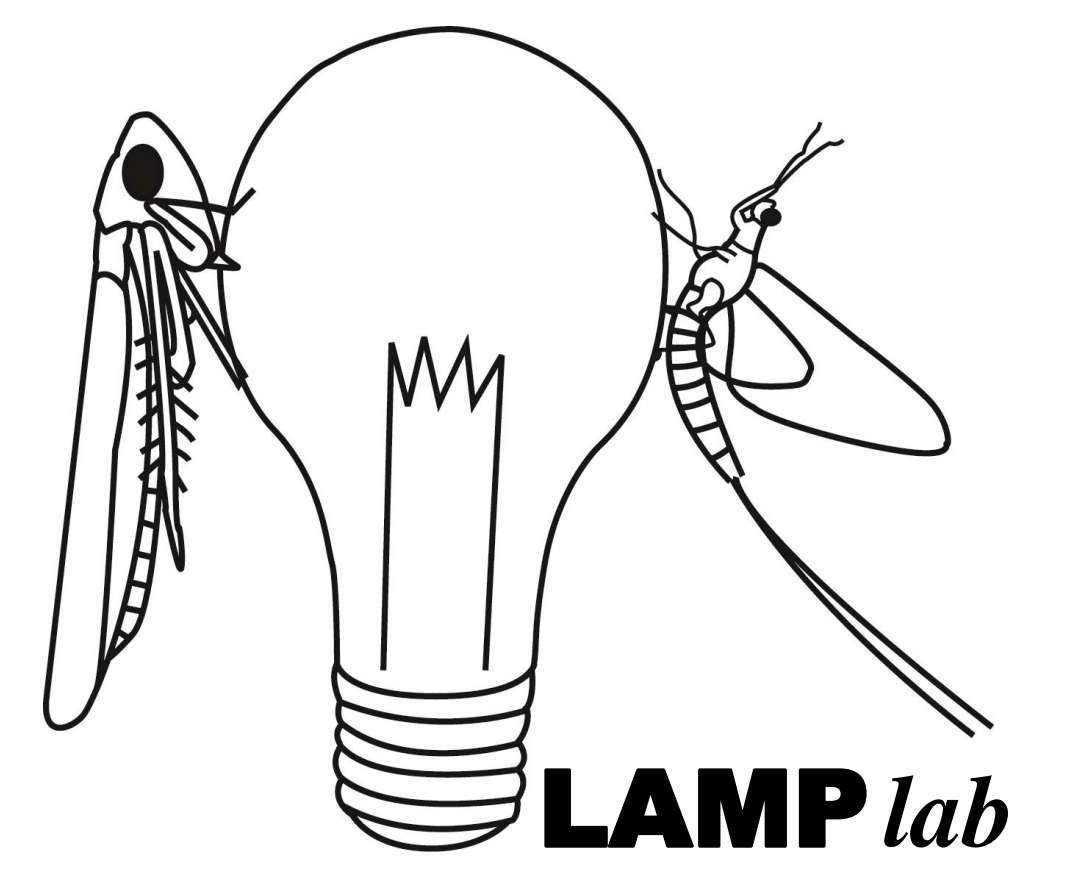


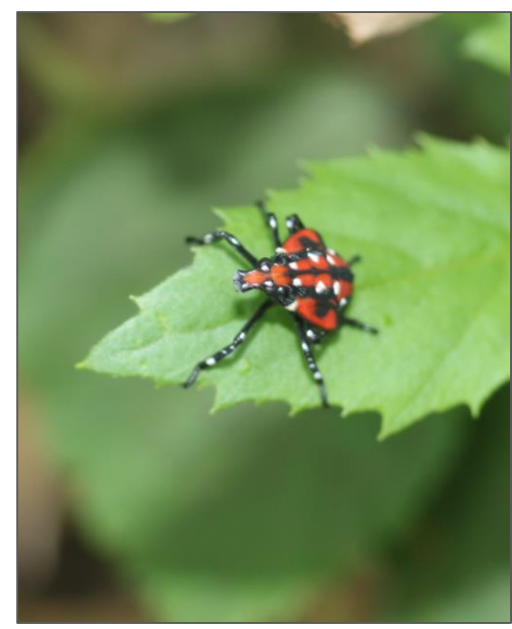
External Morphology of the Spotted Lanternfly, *Lycorma delicatula*, in Relation to Host Plant Use: Development of the Arolia and Mouthparts

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Introduction and Objectives



The invasive spotted lanternfly, *Lycorma delicatula* (Hemiptera: Fulgoridae) is an economically important rapidly spreading invasive insect pest in the eastern US. In October 2018, the first individual was detected in Maryland. The lanternfly causes substantial damage to many woody plants by sucking phloem sap, reducing photosynthesis, causing weeping wounds, and creating conditions for sooty mold.

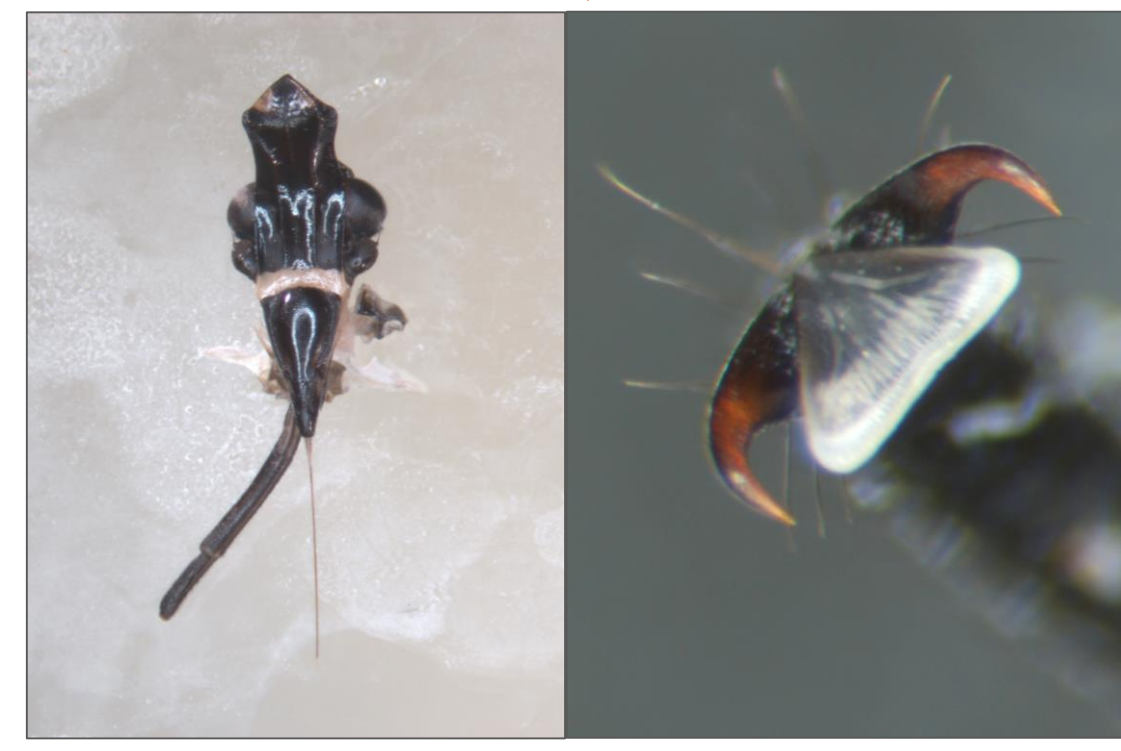
Lanternfly nymphs switch host plants during their development. However, little is known about relationship between the lanternfly and its tree hosts, and particularly about morphological adaptations of the lanternfly to host plant usage at each developmental stage of the pest. In this study we focused on **two objectives**: (1) to assess changes in morphology of the lanternfly mouthparts (stylets and labium), and (2) to assess changes in morphology of the lanternfly tarsal tips (arolia and tarsal claws) at each developmental stage. We expect the lanternfly mouthparts and tarsal tips to be highly adapted to various host trees and to undergo structural changes throughout the development. This information will be especially critical to help predict lanternfly dispersal to new host trees at each developmental stage, and ultimately prevent rapid infestation of valued woody plants.

Methods

- We collected about 50 insect individuals (approx. 10 individuals per developmental stage) from 13 different host trees at three locations in Berks County, PA in July 2018. The insects were immediately preserved in ethanol.

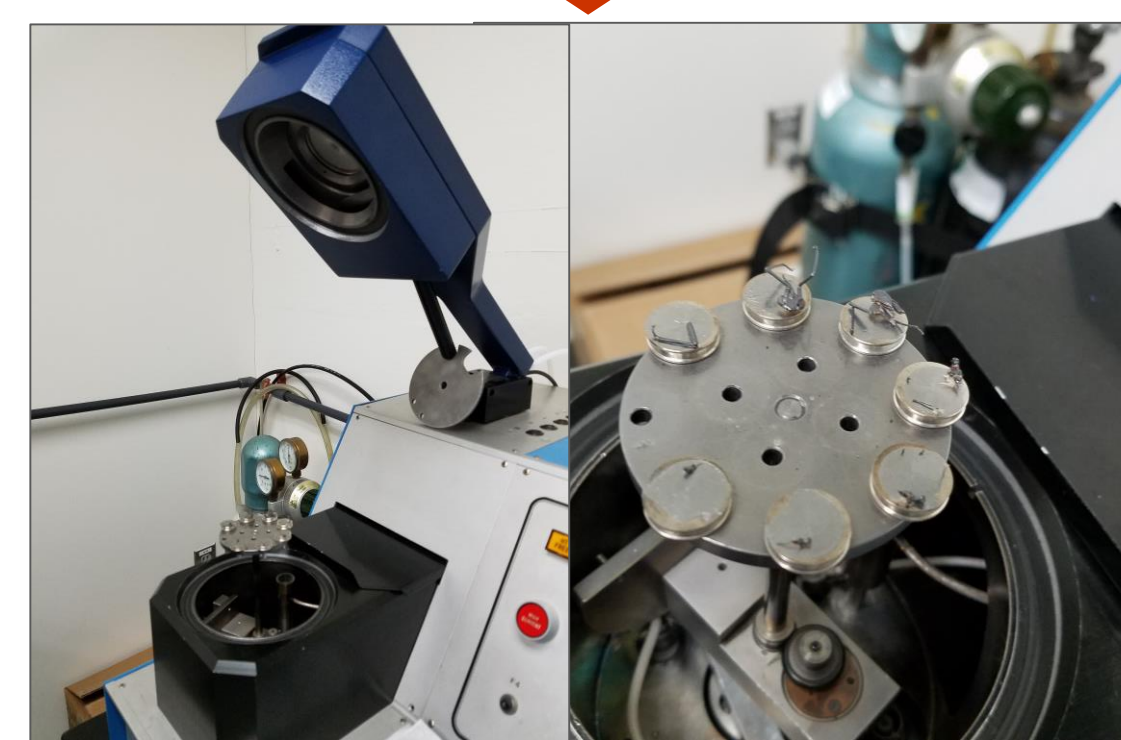


- The mouthparts and tarsi from three individual insects at each developmental stage were isolated under the dissecting microscope.

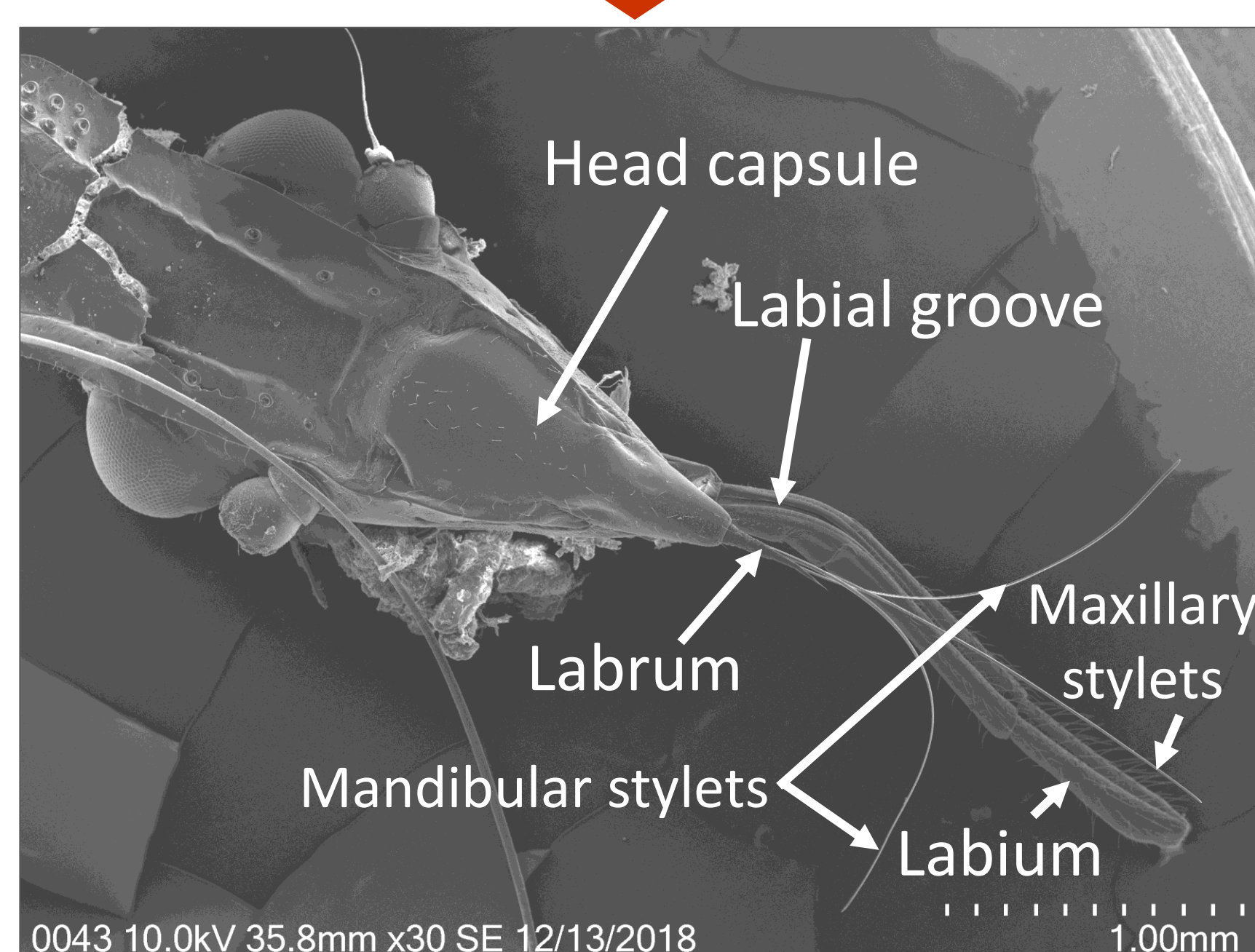


- Then, isolated mouthparts and tarsi were transferred to a fixation solution for scanning electron microscopy.

- Tissue fixation was done using modified hexamethyldisilazane drying technique, and using resources for scanning electron microscopy located in the Laboratory for Biological Ultrastructure.



- The morphology of the stylets and tarsal tips were investigated, size measurements were taken (not shown here), and all the morphological structures were photographed.

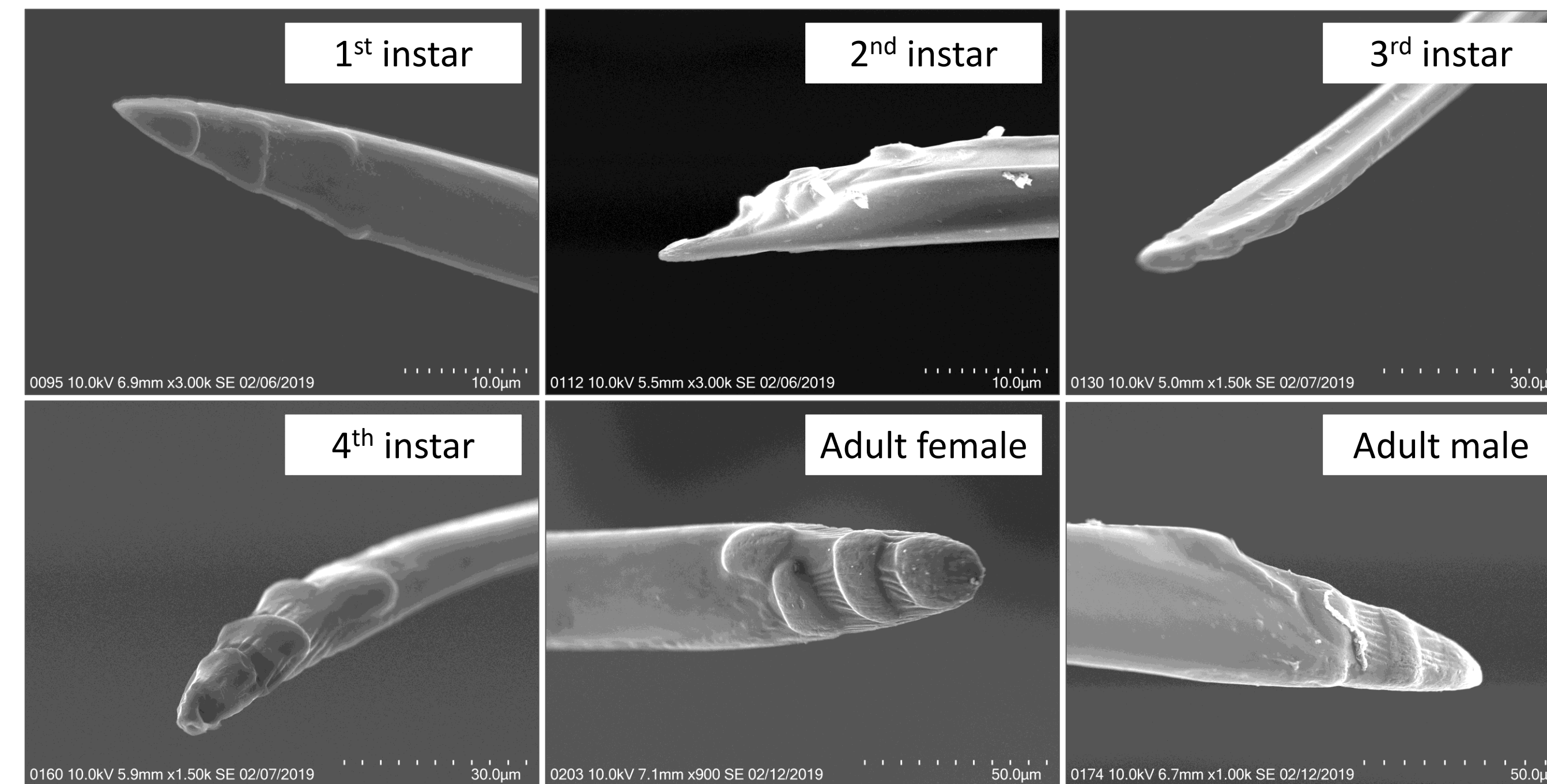


- Each photograph served as a reference for identification and morphological analysis of mouthparts and tarsal structures at each developmental stage of the lanternfly.

Results

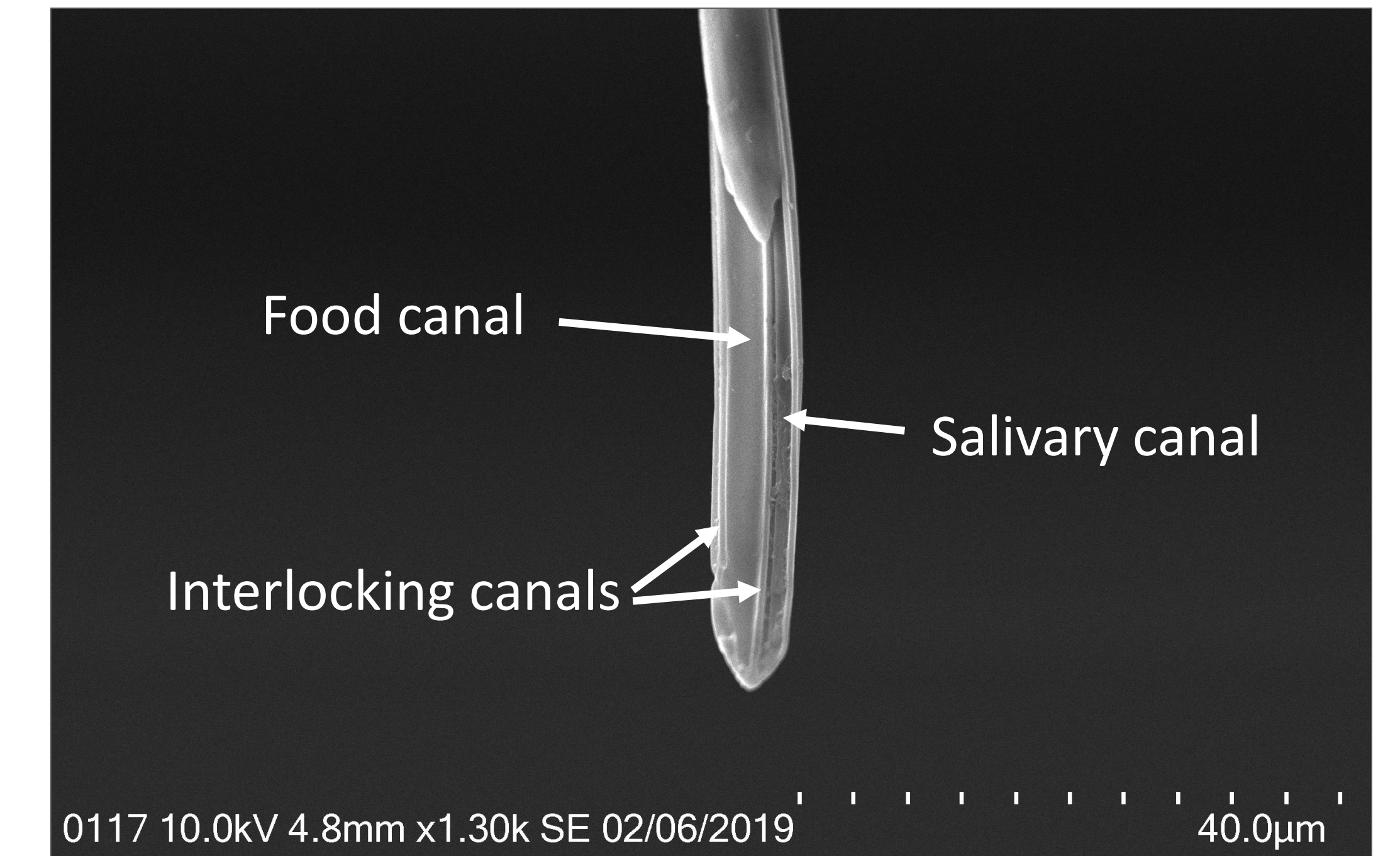
Mandibular stylets

At each developmental stage, tips of mandibular stylets possess a number of oval prominences and longitudinal striations (in 4th nymphal instars and adults only) on the outer surface; while the inner surface of the stylets is smooth.



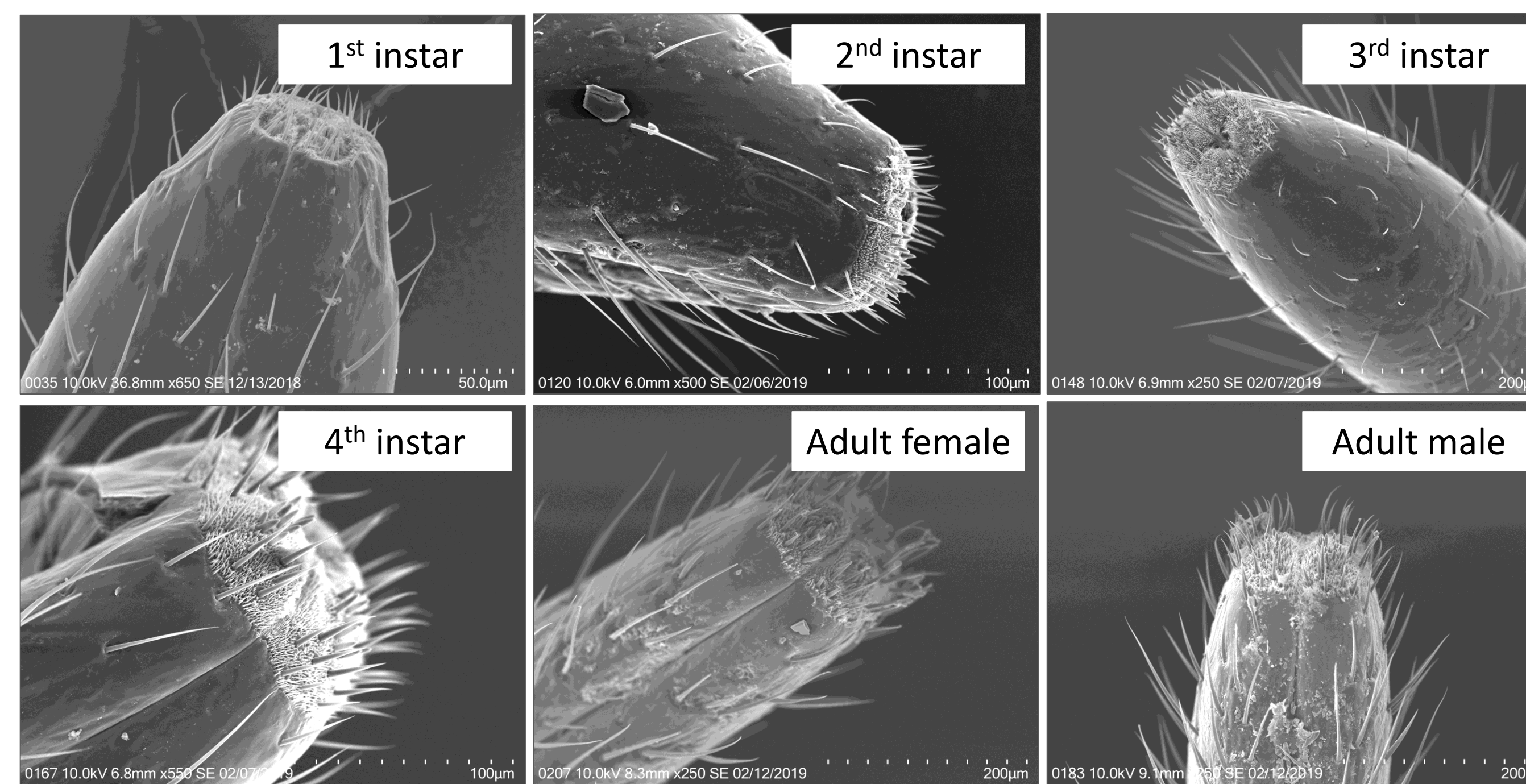
Maxillary stylets

Maxillary stylets are morphologically similar across all the developmental stages. These stylets have smooth outer surface throughout their length. In the inner surface, we observed the food canal, salivary canal and two interlocking canals.

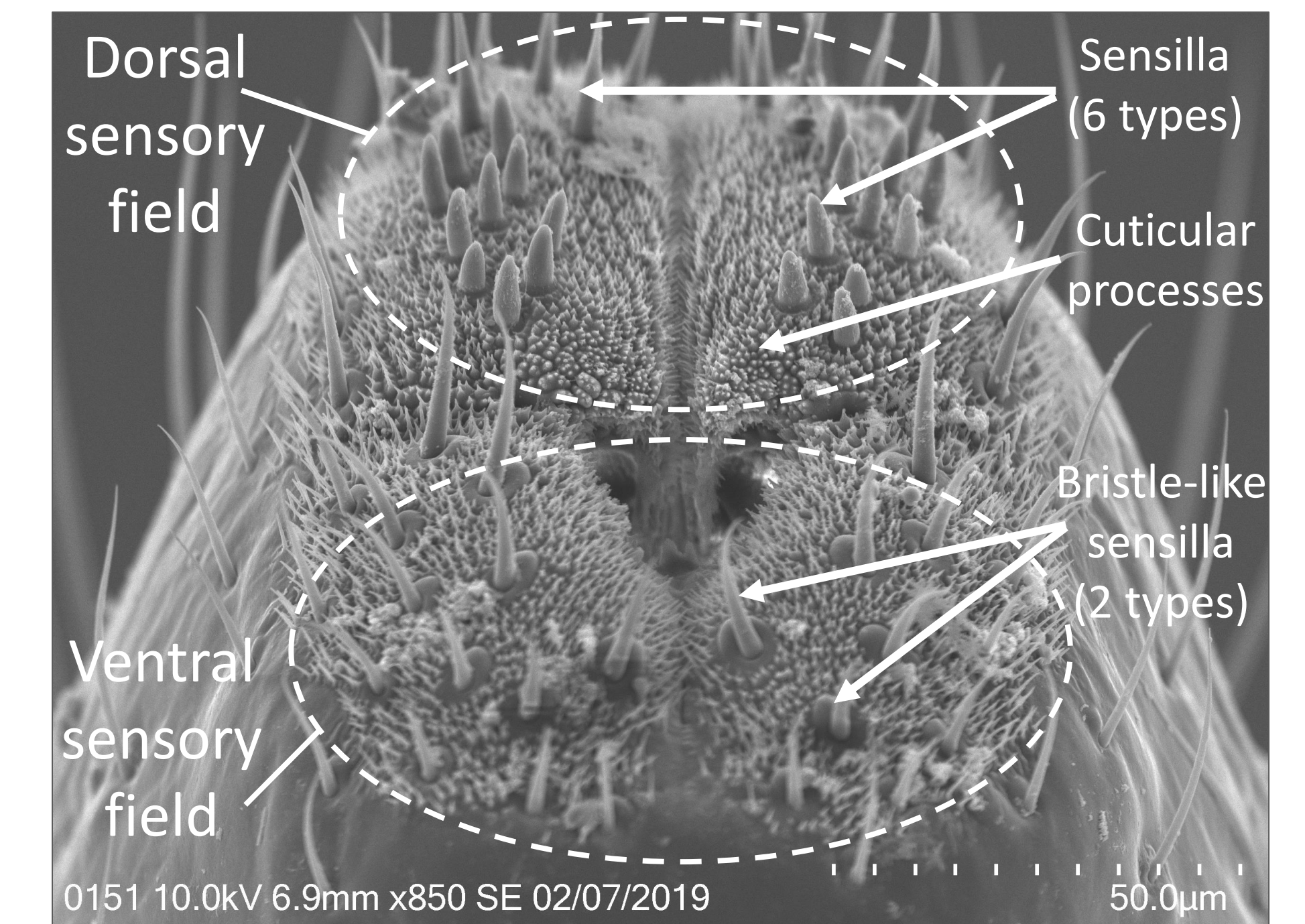


Labium: Labial Tip + Labial Sensilla

The labium consists of four segments in 1-4th nymphal instars and five segments in adults; the third segment is the longest one in instars, and the fourth one is the longest labial segment in adults.

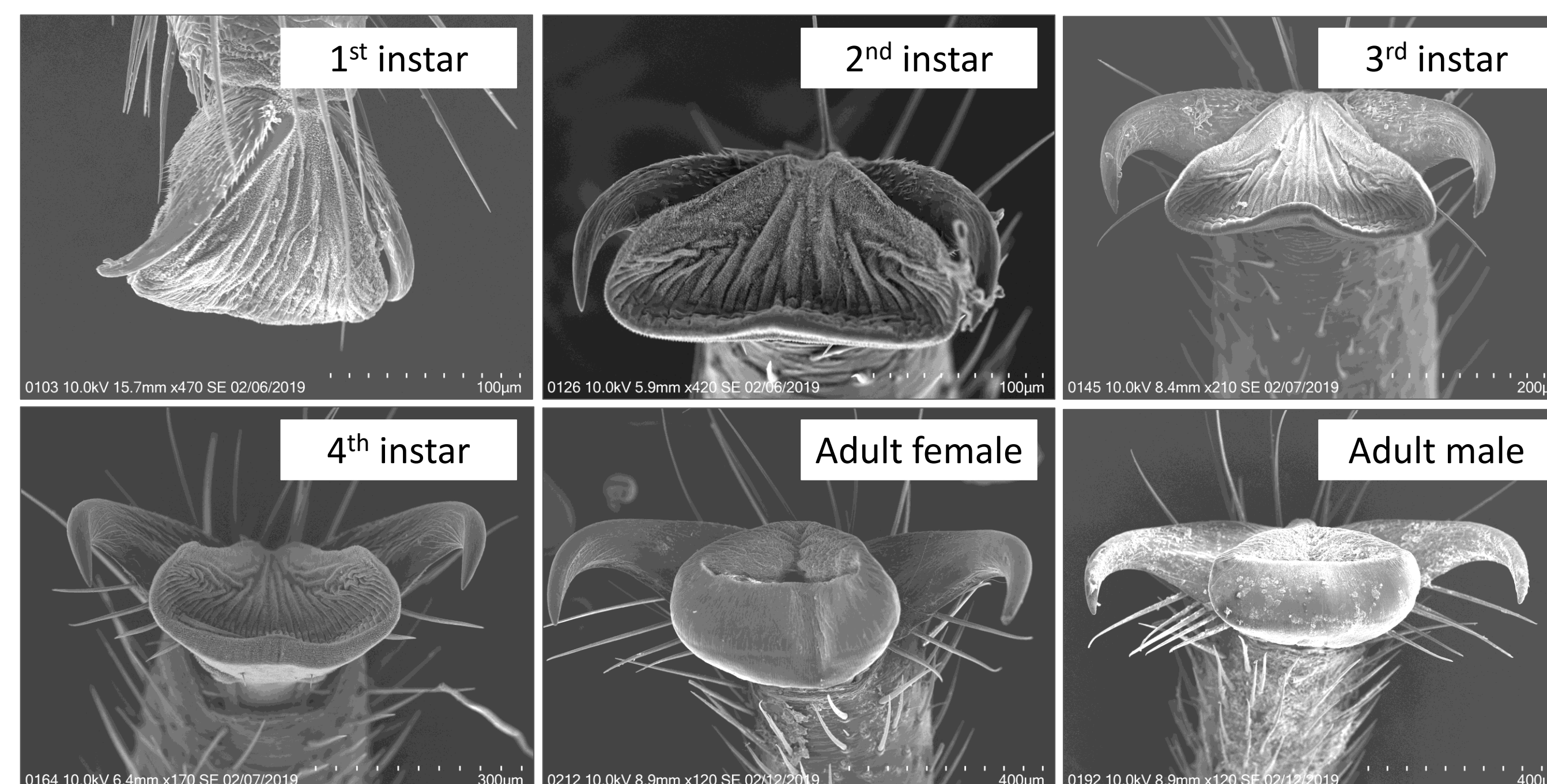


At each developmental stage, the tip of the labium is divided into two lobes by the labial groove: each lobe carries one ventral and one dorsal sensory field which have numerous sensilla. Sensilla are surrounded by cuticular processes which differ on each sensory field (Brozek and Bourgoin, 2013)

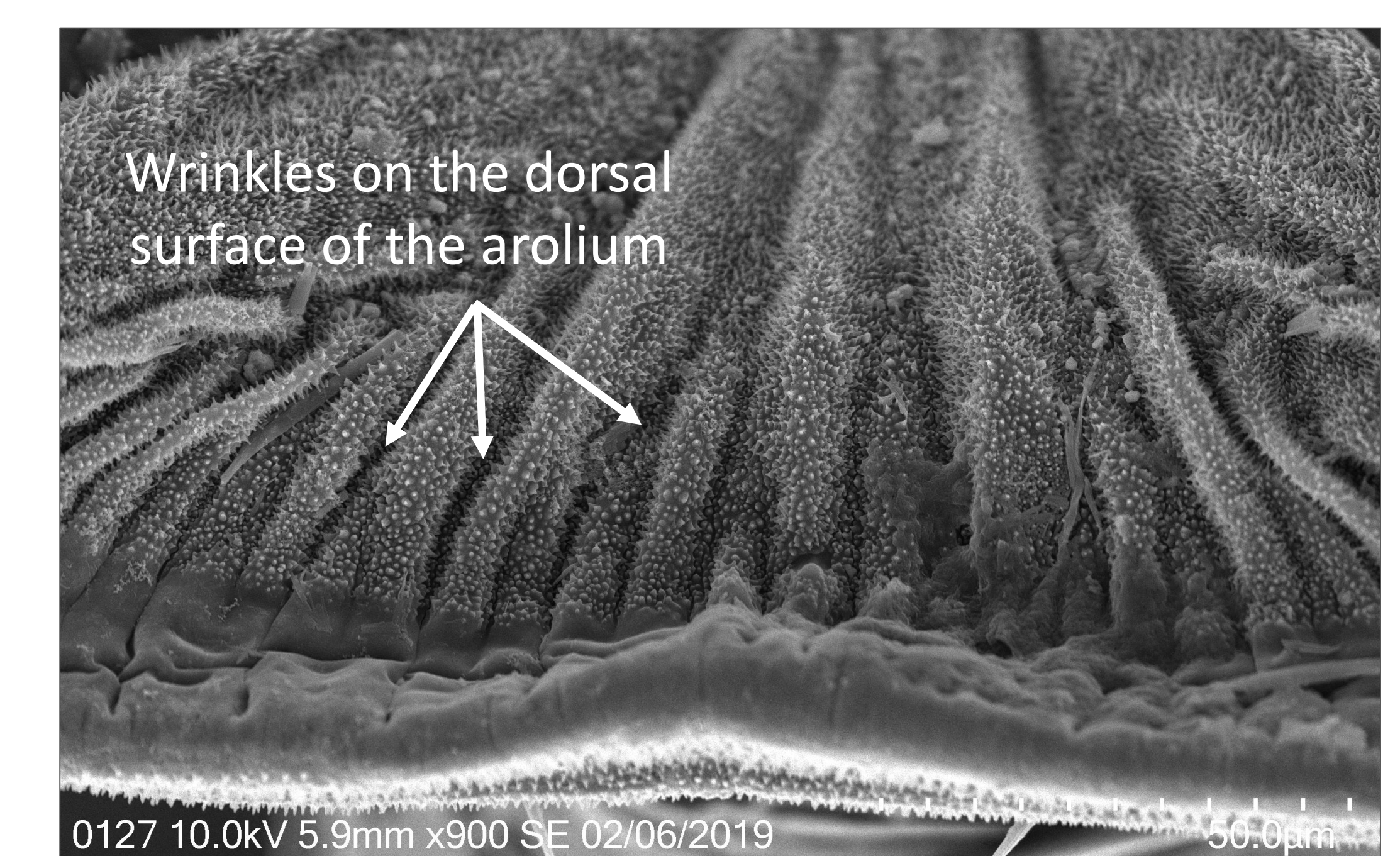


Tarsal Tip: Tarsal Claws + Arolium

Each tarsal tip in the spotted lanternfly carry two tarsal claws and an arolium. We observed that in adults the tarsal claws are more spread out than that in the nymphal instars; in the early instars (1st and 2nd) the claws are located very close to the arolium.



Following Frantsevich et al. (2008), we observed that the dorsal surface of the arolium forms wrinkles which are more defined in adults, especially when the arolium is not completely spread out.



Conclusions and Future Directions

In this study we explored morphology of mouthparts and tarsal tips at each developmental stage of the lanternfly, and specifically the structures which are responsible for primary contact with host tree surface (i.e. stylets, labium, tarsal claws, and arolia). We observed the following interesting **patterns**:

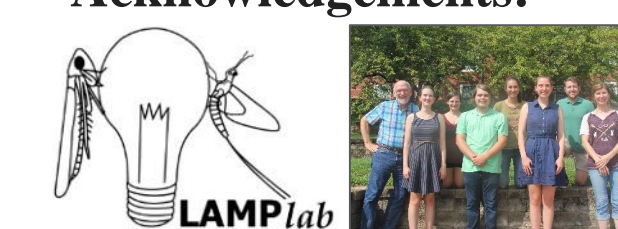
- Oval prominences and longitudinal striations are more defined in 4th instar and adults; labium is more segmented in adults; numerous sensilla, including the bristle-like sensilla, on the tip of the labium are present at each developmental stage; we didn't observed any differences between adult males and females
- Tarsal claws are more spread out in adults; arolia are fully developed at each stage; arolia surface becomes more wrinkled in adults

We hypothesize that observed patterns are adaptations to host plant usage and correspond with a type of host plants utilized at each developmental stage. For future research, we are going to focus on morphometric comparisons of mouthparts and arolia of the spotted lanternfly in relation to its host plant usage.

References and Acknowledgments

References:
Brožek, J., & Bourgoin, T. (2013). Morphology and distribution of the external labial sensilla in Fulgoromorpha (Insecta: Hemiptera). *Zoomorphology*, 132(1), 33-65; Frantsevich, L., Ji, A., Dai, Z., Wang, J., Frantsevich, L., & Gorb, S. N. (2008). Adhesive properties of the arolium of a lantern-fly, *Lycorma delicatula* (Auchenorrhyncha, Fulgoridae). *Journal of insect physiology*, 54(5), 818-827.

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