ULTRASTRUCTURAL CONTRIBUTIONS TO THE STUDY OF THEGLASSY-WINGED SHARPSHOOTER AND PIERCE'S DISEASE

Project Leader:
Thomas P. Freeman
Electron Microscopy Laboratory
North Dakota State University
Fargo, ND 58105

Cooperators:
Roger A. Leopold, Dennis R. Nelson and James S. Buckner
USDA-ARS, Biosciences Research Laboratory
Fargo, ND

Thomas J. Henneberry
USDA-ARS
Western Cotton Research Laboratory
Phoenix, AZ

Reporting Period: The results reported are from work conducted from July 1, 2002 to October 31, 2002.

INTRODUCTION

Despite the major research efforts presently underway to minimize the significant economic losses caused by the glassy-winged sharpshooter and Pierces's disease there are major gaps in our understanding of the basic biology of this insect and its interactions with host plants. There is little current literature dealing with the structure of mouth parts of the glassy-winged sharpshooter. Understanding the structure of the mouths parts and their interaction with host plant cells is essential to determining how the insect transfers the bacterium from plant to plant. Details of the mouth parts and feeding behavior may also provide the information necessary to determine why some sharpshooters can feed on infected plants but not transfer the bacteria to healthy plants on subsequent feedings. There is speculation as to why the cavitation does not occur in the xylem tissue despite the large water loss associated with sharpshooter feeding. Preliminary evidence from our laboratory demonstrates that both immature and adult insects probe leaf blades and petioles but never actually penetrate the xylem tissue of the veins. Are these insects actually feeding on cells outside of the xylem tissue? The research outlined in this report will contribute significantly to a greater understanding of glassy-winged sharpshooter feeding and its relationship to Pierces's disease.

OBJECTIVES

1. Describe the morphology and ultrastructure of the glassy-winged sharpshooter mouthparts.
2. Describe the process of stylet penetration and the function of each stylet pair during feeding.
3. Ascertain the path of the mouth parts from the epidermal layer to the vascular tissue of the host plant and to ascertain if the sharpshooter has fed in parenchymatous or phloem tissue en route to xylem tissue.
4. Determine the ultrastructure of the salivary sheath and its association with all plant tissues encountered from the epidermal layer to the xylem tissue.

RESULTS AND CONCLUSIONS

Glassy-winged sharpshooters (GWSS), *Homalodisca coagulata,* were field collected from citrus and eucalyptus in Ventura, California, July 2002. Additional insects and plants were obtained from the Oswald Street Biological Control Station, Bakersfield California. Light and electron micrographic studies were used to describe the sharpshooter mouth parts (Figures. 1-5) which consist of a labrum, labium, and stylet fascicle. The three-segmented labium contains the fascicle bundle composed of two external mandibular stylets and two internal maxillary stylets. The stylets are capable of rapidly penetrating leaf tissue or woody stems.

The crescent-shaped mandibular stylets taper to sharp points at their tips (Figure 2) and have elaborate sculpturing along their borders (Figure 3). Each stylet is manipulated by retractor and protractor muscles that allow independent movement of the stylets. On the medial surface of each stylet is a series of cup-shaped flanges that are more prominent near the tip of the stylet. The two mandibular stylets are morphologically distinct.

The maxillary stylets (Figure 4) are longer than the mandibular stylets and are semicircular in cross sectional view (Figure 5). These stylets are interlocked along their entire length with the exception of the very tip. They interlock similar to a mortise and tenon type of joint forming a smooth central tubular food canal and salivary canal (Figure 5). Dendritic canals are evident in both the mandibular and maxillary stylets.

Sharpshooters can relocate from one feeding position to another and be producing exudate within thirty seconds. Many of the salivary sheaths formed are highly branched. Although the sharpshooter is considered to be an exclusive xylem feeder, a high proportion of the salivary sheath branches do not terminate in the xylem tissue (Figure 6).

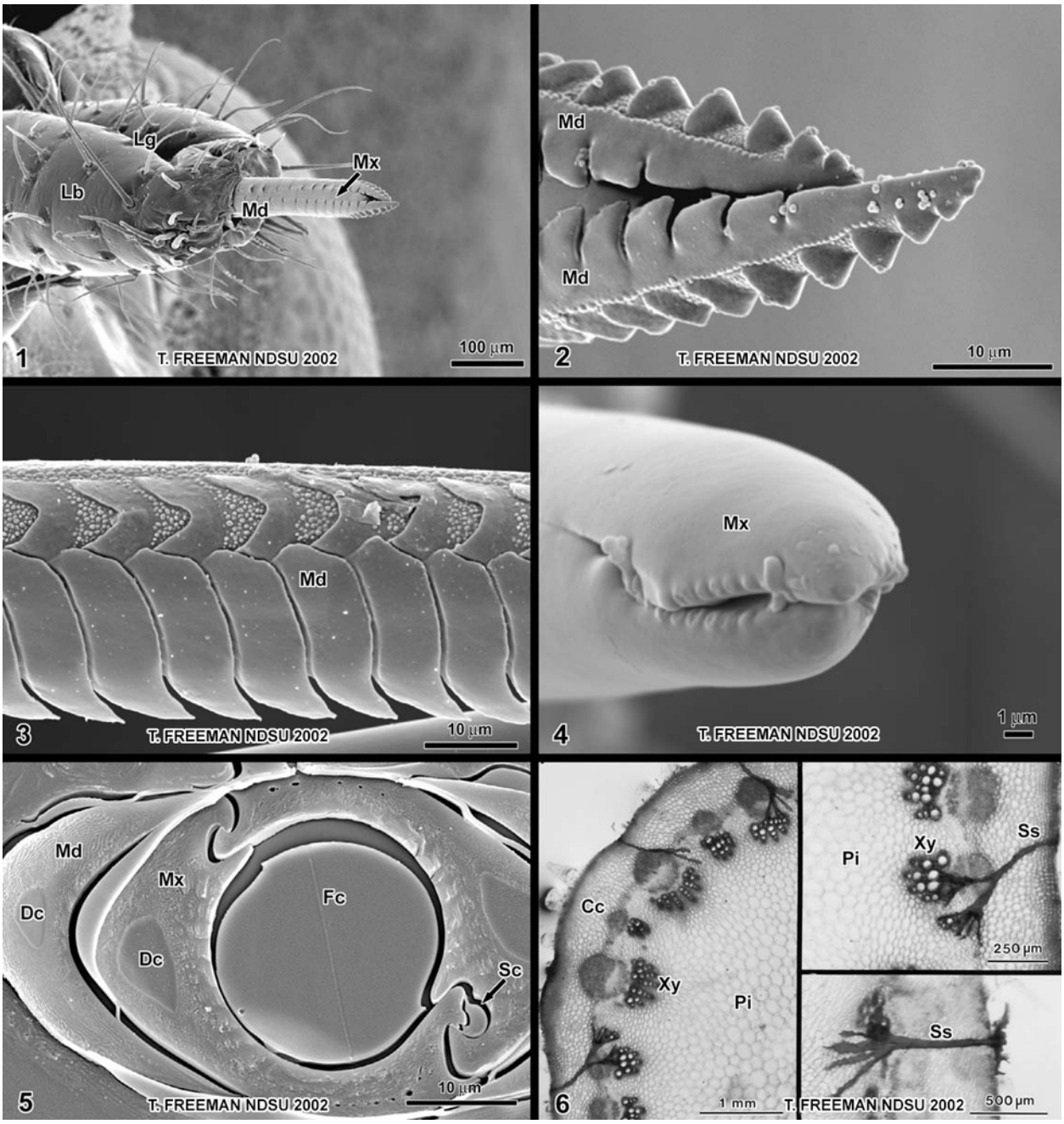

Figure 1. Mandibular and maxillary stylets extended beyond the tip of the labium.
Figure 2. Mandibular stylet tips of a nymph.
Figure 3. Dorsal view of an adult mandibular stylet.
Figure 4. Tips of the maxillary stylets of an adult.
Figure 5. Cross sectional view of the stylet fascicle.
Figure 6. Cross sections of sunflower stems showing salivary sheaths.
Cc - cortex, Dc - dendritic canal, Fc - food canal, Lb - labium, Lg - labial groove, Pi - pith, Md - mandibular stylet, Mx - maxillary stylet, Sc - salivary canal, Ss - salivary sheath, Xy - xylem.

FUNDING AGENCIES
Funding for this project was provided by the University of California Pierce's Disease Grant Program.