HOW ADULT WHITEFLIES FEED ON COTTON LEAVES

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Abstract

The stylet bundle of the adult whitefly, *Bemisia argentifolii*, is completely contained within a groove in the labium. The adult lowers its head in order to push the tip of the stylet bundle into the leaf. The length of the adult stylet bundle is sufficient to allow the adult to reach a vein, phloem tissue, from any position on the leaf, either abaxial or adaxial surfaces.

Introduction

The importance of cotton leaf morphology in influencing the ability of the whitefly to locate, penetrate, and reach phloem tissue in order to feed has long been a point of interest. Our earlier theory (Cohen et al., 1998) proposed that whiteflies feed and oviposit on the abaxial surface (underside) of leaves due to the closer proximity of phloem tissue to that leaf surface. The length of the stylet bundle was believed to be a limiting factor necessitating that the insect feed from the abaxial surface of the leaf.

With scanning electron microscopy we have determined the depth of phloem tissue in the cotton leaves and have described the path the stylet bundle takes to reach the phloem tissue. We have measured the length that stylet bundles have penetrated the leaf. We have determined how to measure the portion of the total stylet length that is utilized in any individual penetration.

Discussion

The adult feeding apparatus consists of a four-segmented labium in which is contained a slender stylet bundle (1.5-2 micrometers in diameter; about 0.00007 inches), consisting of two mandibles and two maxillary stylets (Fig. 1). The stylet bundle is contained within a deep groove in the labium (Fig. 2). In order to penetrate the leaf and feed, the adult places the tip of the labium against the surface of the leaf (Fig. 3). It then lowers it head down over the top of the labium, pushing the stylet bundle out the end of the labium and into the leaf (Fig. 4).

The adult stylets ranged in length from 132 to 313 micrometers (0.005 to 0.012 inches). The adult can push the entire stylet bundle into the leaf. Therefore, it can penetrate a distance of up to 313 micrometers. This length is more than sufficient to reach phloem tissue which is within 53 to 127 micrometers of the abaxial surface on leaves found on the top 20 nodes of field grown cotton (Chu et al., 2000). These authors also found that cotton leaves have a dense network of minor veins (not previously recognized) which provide numerous feeding sites and lead to the conclusion: "a minimal physical movement and random probing may provide easy access to veins from any location of the abaxial leaf surface." (Chu et al., 2000).

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Summary

The length of the adults stylet bundle, and therefore, the distance it can penetrate the leaf, can be determined by measuring the length of the last three labial segments. The length of the stylet bundle is sufficient to allow the adult to reach a phloem bundle from any position on either the abaxial or adaxial surfaces of the cotton leaf.

References

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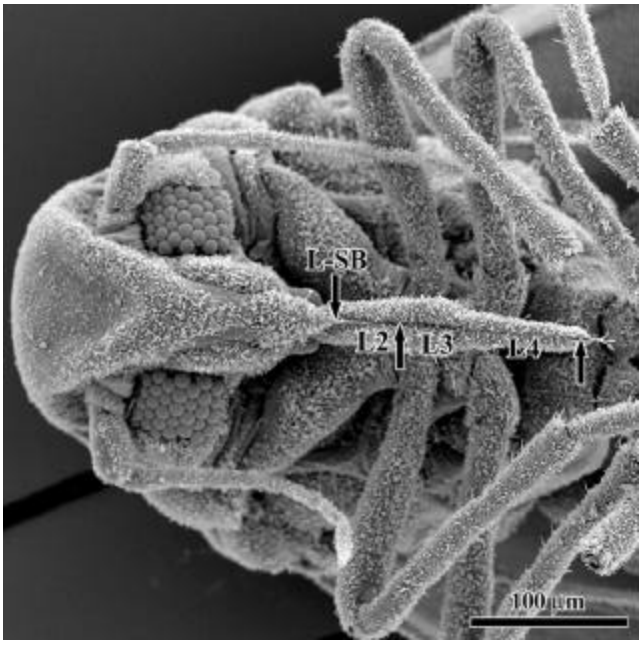

Figure 1. Frontal view of an adult silverleaf whitefly showing the labrum, labium, and separated stylets of the stylet bundle extending beyond the labium. L-SB is the point at which the stylet bundle is attached to the labrum. L2, L3 and L4 are the 3 distal segments of the 4-segmented labium. The two arrows point to the labial groove in which the stylet bundle is contained.

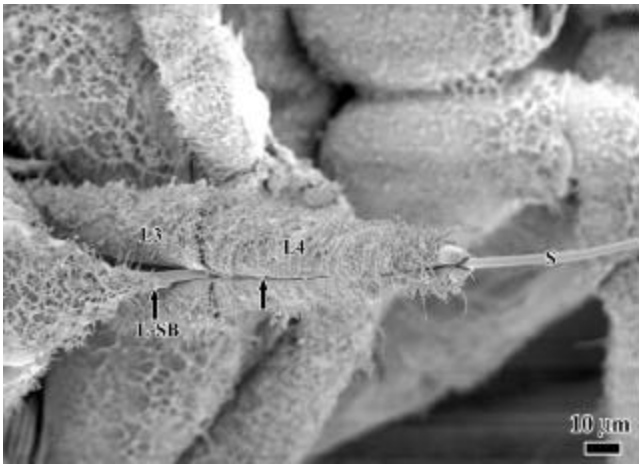

Figure 2. A close-up view of the point of attachment of the stylet bundle to the labrum (L-SB), labial segments L3 and L4, the labial groove (arrow), and the stylet bundle (S), which had been inserted into a cotton leaf. The position of L-SB along the labial groove indicates that approximately 50% of the stylet bundle has penetrated the leaf.

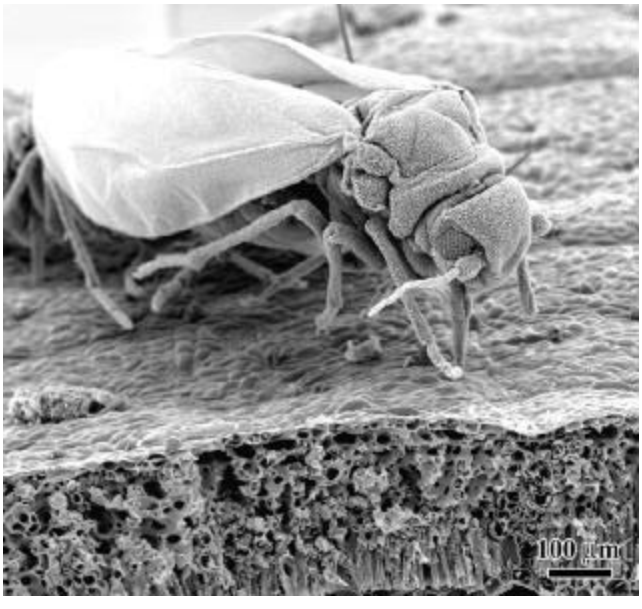

Figure 3. An adult feeding on the abaxial surface (lower surface) of a cotton leaf. The position of the head indicates that approximately 50% of the length of the stylet bundle has been inserted into the leaf.

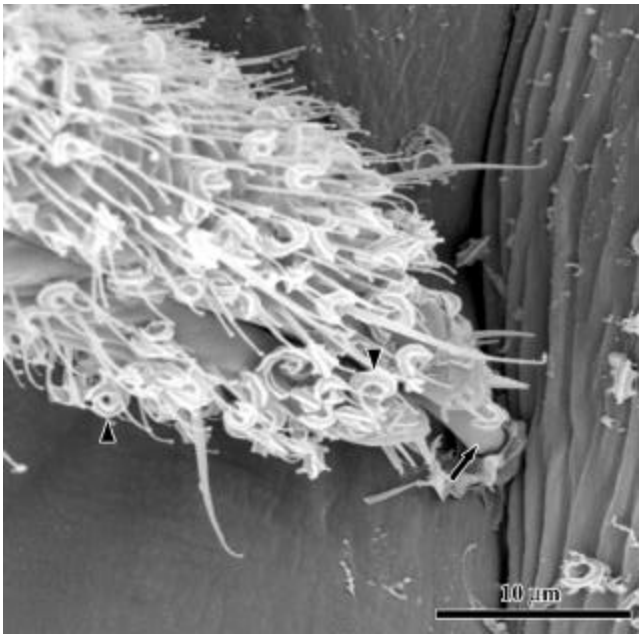

Figure 4. Close-up view of the tip of the labium with the stylet bundle (arrow) penetrating a cell on the abaxial surface of the cotton leaf. Semicircular particles (arrowheads) covering the labium are found over the adult except for the eyes, and are waxy particles produced by the wax glands of both male and female adults.