HOW DO SHARPSHOOTER LEAFHOPPERS FEED AND SURVIVE ON NUTRITIONALLY DEPAUPERATE XYLEM FLUID?

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Sharpshooters (Cicadellidae: Cicadellinae) are large, tropical and semi-tropical leafhoppers that are unique among all non-sessile hemipterans in ingesting primarily from xylem vessels. This presentation will summarize research on behavioral and physiological adaptations that permit sharpshooters to pump xylem sap under extreme tension, and survive on such a nutrient-poor food source. Sharpshooter stylet penetration is intracellular, and includes active uptake of fluid to precibarial chemosensilla to taste plant constituents both along the pathway to the xylem and inside xylem vessels, as demonstrated by electrical penetration graph monitoring of insect feeding, electromyography, and X-ray studies of cibarial muscle movements. Several xylem vessels can be punctured, tested, and abandoned before a suitable cell is found and accepted. The salivary sheath coats the point of puncture into a xylem vessel, forming a lining that chemically loosens and penetrates the cell wall. Thus, hardened saliva mechanically seals stylet tips into the xylem, preventing cavitation, as demonstrated via magnetic resonance imaging. Counterintuitively, sharpshooters apparently rely upon xylem tension to aid cibarial pumping, because such pumping becomes labored and eventually ceases when a host plant is not actively evapotranspiring. Cicadellines exhibit dietary mixing, i.e. feeding from numerous hosts to optimize consumption of certain xylem constituents. The majority of sharpshooters' time on plants is spent ingesting, resulting in large volumes of excreta (several times body weight in 24 hours). The highly efficient filter chambers of sharpshooters concentrate nearly all organic compounds in xylem fluid for absorption. Sharpshooters further conserve energy by being the only terrestrial organisms that excrete pure ammonia (ammonotelism). Finally, several species of endosymbiotic bacteria produce essential nutrients not found in xylem fluid. Thus, sharpshooter physiology is supremely adapted to subsist on xylem fluid.

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