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Why Do We Study Auchenorrhynchan Feeding Processes?

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The Symposium on Feeding Processes and Their Role in Hopper-Plant-Microbe Interactions will highlight the multi-facetted role of feeding in the life of Auchenorrhynchans, a topic that is a bridge across many disciplines in the study of these insects. The speakers in this Symposium will provide their diverse discipline's insights, both empirical and theoretical, from many points of view, into the many aspects of feeding. The Symposium will emphasize holistic blends of modern techniques, often presented by interdisciplinary teams of researchers in the field. It also will emphasize interactions between Auchenorrhynchan feeding and other organisms such as microbes (both vectored and non-vectored) and plants. This preview of the Symposium will give an overview of Auchenorrhynchan feeding, provide some additional information that will not be covered in the Symposium, explain why these studies are important, and introduce the major topics and speakers.

The very earliest natural history studies of Auchenorrhyncha noted their highly specialized, piercing-sucking mouth parts. It has always been recognized that understanding the anatomy, or "plumbing", of the feeding structures informs our understanding their function. It wasn't until the late 1800's that detailed, empirical studies began, culminating eventually in the major works of (Snodgrass 1935) and (Goodchild 1966). In the Symposium's first paper, Wayadande and Ammar will review modern work on the anatomy of the alimentary canal and salivary glands, discussing how understanding functional anatomy is crucial for explaining the mechanisms of pathogen transmission by vectors. This preview talk will complement their talk by providing some extra information on the sensory systems that control feeding.

The insect arrives at the plant armed with an array of anatomical devices to penetrate the plant tissues and propel the tips of the stylets into position to ingest from only certain cell types within the plant. This selection is highly specialized within the Auchenorrhyncha, uniquely among all animals on Earth. Depending upon the taxonomic family or subfamily, different insects normally prefer to ingest from either vascular tissues (usually phloem or xylem, seldom both) or parenchyma/mesophyll tissues. They do so utilizing different strategies or sub-strategies (tactics) of feeding behavior that also differ by taxonomic group (Miles 1972, Backus et al. 2005). This preview talk will introduce the feeding strategies and stylet penetration tactics as well as the Auchenorrhynchan taxa that use each. Three presentations will elaborate on these very specialized stylet penetration behaviors. Bextine and Walker will provide an overview of stylet penetration by sheath-feeding leafhoppers, and how such details can aid in management of glassy-winged sharpshooter. Reynaud will discuss sheath-feeding planthoppers. Ranger will discuss cell rupturing leafhoppers and the behaviors that cause their direct feeding damage. These wide-ranging talks will also examine methods for how we study stylet penetration, examples of how such intricate feeding behaviors facilitate exploitation of the host plant, ways the host plant can resist that exploitation, and also how feeding behavior controls transmission of plant pathogens by vectors. One of the most rigorous and informative methods used to study feeding is the electrical penetration graph (EPG). All of the speakers in this section will discuss findings from EPG studies, as well as other types of studies. My introductory talk for the afternoon session will be a quick overview of the principles and applications of EPG, and the talk by Reynaud in the Symposium will describe some of the latest methods used for automated, computerized analysis of EPG waveforms.

Feeding behavior allows the insect to consume (sometimes very large) quantities of fluid from its host plants. Coudron, Hunter and Labavitch will blend their expertises in insect nutritional biochemistry and molecular genetics as well as plant biochemistry for their presentation. They will discuss both existing results and testable theories about the interplay among feeding (including extra-oral digestion by saliva), midgut digestion, and nutrition. Finally, Mizell (an entomologist) and Anderson (a plant chemist) present an integrated picture of the complex interactions among vector feeding and nutrition, plant chemistry, and natural enemies, using the glassy-winged sharpshooter as a model system.

Finally, we will bridge from this Symposium on the functions of feeding across to Chris Dietrich's symposium on the evolution and phylogeny of Auchenorrhyncha, by examining fossil evidence for piercing-sucking feeding. This preview

talk will summarize the elegant work of Conrad Labandeira (who was unable to attend the Congress), on how fossilized feeding tracks, salivary sheaths, and insect mouthparts suggest the feeding behavior and physiology of ancient Auchenorrhynchan ancestors and ecological analogues.

To answer the question posed in the title, we study Auchenorrhynchan feeding because it is fascinating. The details are unique in the Animal Kingdom, it has been mysterious for many years until the advent of improved technology, and knowledge of these details leads to better understanding of all aspects of these insects' lives and interactions with other organisms. Ultimately, sustainable means of managing populations of agricultural pest species will depend in part on such knowledge.

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