

X-WAVE FILES: STEREOTYPICAL VASCULAR CELL-PROBING ACTIVITIES REVEALED BY EPG

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Vascular sap-ingesting hemipterans must overcome a number of host plant defense mechanisms to establish the strong stylet connection necessary to sustain ingestion from phloem sieve elements or xylem tracheary elements. Using electrical penetration graph (EPG) technology, many hemipteran species representing several taxa have been recorded. Resulting waveforms have been identified, characterized and correlated using histology and biochemical tests to determine stylet location within plants. Historically, three waveform types have been associated with stylet activities in vascular cells, i.e. phloem salivation, sustained phloem or xylem ingestion, and another waveform that usually precedes the first two. The latter waveform has been assigned a myriad of behavioral interpretations and names, but its original designation has been the most enduring: the X-wave. By definition, the X-wave is a waveform that is stereotypical in appearance, comprising repeated phrases, and is produced upon first stylet contact with phloem or xylem. The X-wave is easily recognized in all types of EPG outputs, and X-waves of related hemipteran species share common characteristics. Here, X-waves from three sheath-feeding leafhoppers, two aphids, one psyllid, and one true bug, are presented, analyzed, and discussed. In addition, a compilation of X-waves and their interpretations from the literature are considered. Finally, it is proposed that X-waves represent stereotypical vascular-cell-acceptance and conditioning behaviors for each species, and that X-waves may be used as quantifiable taxonomic characters for phylogenetic analyses. Colleagues are invited to contribute EPG-X-waves from their study species, and to collaborate on future research to test this hypothesis.