

"Sentio ergo sum" – morphology and ultrastructure of the antennal sensilla of aphids (Hemiptera: Aphidomorpha) and their evolutionary significance

Although bugs or hemipterans (Insecta: Hemiptera) are one of the five largest and most important insect orders, primarily due to their economic and epidemiological contemporary and fossil taxa, their classification is still the subject of numerous studies and discussions.

Although aphids (Hemiptera: Aphidomorpha), which have more than 5000 recognised species, are a small percentage of Hemiptera, their biology, life cycles and their results – polymorphism, high ecological plasticity and ultimately their evolutionary success, have made them one of the most important groups, economically and phylogenetically, not only within bugs but within insects as a whole.

Aphids, like other bugs and insects, are characterised by the presence of various sensory structures that are located on the antennae (paired, several or even several dozen segmented appendages on the head). The most common sensory organs (sensilla) are various types of hairs and setae that are known to be mechanoreceptors (trichoid sensilla) and various types of chemoreceptors: porous sensilla (uniporous, multiporous), placoid, coeloconic sensilla (probably hygroreceptors or thermoreceptors) and campaniform sensilla (probably responsive to pressure). Compared to other insects and most bugs, aphids are characterised by very specific sensory organs on their antennae, which distinguish this group from the others – rhinaria and rhinariola. Rhinaria are of different shapes and specific structures that can be located on many segments of the antennae, although they are most often present on the penultimate and last segment and these are the so-called primary rhinaria (present even in first instar larvae and all of the other morphs). The rhinaria that most commonly occur on the III and IV antennal segments are called secondary and can only be found in adult aphids (especially in winged morphs). In terms of functionality, they are most likely chemoreceptors. The most interesting rhinaria appear to be the primary rhinaria on the last antennal segment, among which we can distinguish large and small placoid sensilla and coeloconic sensilla. Hair-shaped sensilla and setae are present over the entire surface of the antennae and they are most likely mechanoreceptors.

The main goal of our project will be to perform a detailed study of all of the types of sensilla on aphid antennae based on an analysis of their outer structure on a representative group of species that belong to all of the subfamilies of oviparous and viviparous aphids. Morphological analyses will be supplemented by precise ultrastructural studies in order to create three-dimensional reconstructions.

The results will be used to construct a feature matrix that will in turn provide the basis for inferring the affinity of the species being studied through the presentation of a phylogenetic tree, which will be created in addition to the results of simultaneous molecular analyses. The purpose of this is to trace the evolution of these structures and their importance in the classification of aphids.