

An inordinate fondness of grasses: The paradox relationship between leafhoppers and graminoids

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Grass-like plants include the monocotyledonous groups of the Poaceae, Cyperaceae, Juncaceae and Typhaceae and cover a large proportion of the world's land masses. In Europe their dominance was limited to small areas in the very north and the very southeast as well as to mountainous, coastal, riverine and bog habitats, before man started to turn large parts of the former forest into pastures, meadows and cereal fields.

In contrast to many other plants which contain considerable quantities of secondary compounds, graminoids generally defend themselves against herbivores through silica located in the epidermis. However, these cannot protect against sap-feeders. Graminoids are therefore suitable host plants for leafhoppers (*sensu lato*, Auchenorrhyncha) and other sap-sucking insects.

Nevertheless, the knowledge about the relationships between these two groups is small, since members of both are difficult to identify and since many graminoids grow in mixed-species stands in the field. As a consequence leafhoppers were long considered to be rather unspecific feeders on a variety of grasses, sedges and also of forbs.

Recent analyses of extensive field data gathered in central Europe have shown that grasses and sedges play the most important role as leafhopper hosts, and that monophagy clearly prevails. Nearly 45 % of all central European leafhoppers feed exclusively on graminoids, although this plant group accounts for only 13 % of the central European flora. The proportion of host specialists in this group is unusually high. Nearly 60 % of the grass-feeders and more than 80 % of the sedge-feeders are first- or second-degree monophagous (on plant species or genus level).

Species richness and degree of host specialization of leafhoppers are both positively correlated with height, structural complexity, abundance and area size of their host plants. Numerous congeneric leafhoppers are monophagous feeders on certain grasses or sedges, but feed on hosts belonging to different genera. In contrast genera of arboricolous leafhoppers tend to be more diverse on the same host plant. These data suggest that speciation through host switch is a driving force in leafhopper diversification in grasslands, but less so in woodland.

Several findings of leafhopper – graminoid relationships are rather paradox: (i) The morphological and biochemical diversity of graminoids is low, but the diversity of associated leafhopper guilds is high. (ii) The natural vegetation of central Europe is forest, but the diversity of graminoid-feeders among leafhoppers is higher than those on trees and shrubs. (iii) Graminoids are poor in secondary plant compounds, but most of their associated leafhoppers are host specialists. (iv) Mesophyll-feeders dominate on dicots, phloem-feeders on graminoids, but the content of secondary compounds is generally higher in leaf tissue than in phloem sap.

Further large-scale analyses of insect-host relations in the field may significantly contribute to a better understanding of insect feeding, plant biochemistry and, eventually, the fundamentals of biodiversity.