

Insect-Plant Interactions



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Insects and plants share ancient associations that date from the Carboniferous, some 300 million years ago. Evidence of insect damage preserved in fossilized plant parts indicates a diversity of types of phytophagy (plant-feeding) by insects, associated with tree and seed ferns from Late Carboniferous coal deposits. This manner of feeding certainly brings soil-dwelling insects into contact with plant roots and subterranean storage organs, but specialized use of plant aerial parts by sap sucking, leaf chewing, and other forms of phytophagy arose later in the phylogeny of the insects. Feeding on living tissues of higher plants presents problems that are experienced neither by the scavengers living in the soil or litter, nor by predators.

First, to feed on leaves, stems or flowers, a phytophagous insect must be able to gain and retain a hold on the vegetation.

Second, the exposed phytophage may be subject to greater desiccation than an aquatic or litter-dwelling insect.

Third, a diet of plant tissues (excluding seeds) is nutritionally inferior in protein, sterol and vitamin content compared with food of animal or microbial origin.

Last, but not least, plants are not passive victims of phytophages, but have evolved a variety of means to deter herbivores. These include physical defences, such as spines, spicules or sclerophyllous (hardened) tissue, and/or chemical defences that may repel, poison, reduce food digestibility, or otherwise adversely affect insect behaviour and/or physiology. Despite these barriers, about half of all living insect species are phytophagous, and the exclusively plant-feeding Lepidoptera, Curculionidae (weevils), Chrysomelidae (leaf beetles), Agromyzidae (leaf-mining flies) and Cynipidae (gall wasps) are very speciose.

Plants represent an abundant resource and insect taxa that can exploit this have flourished in association with plant diversification. This lecture begins with a consideration of the evolutionary interactions among insects and their plant hosts.

We then go on to describe the vast array of interactions of insects and living plants, which can be grouped into three categories, defined by the effects of the insects on the plants.

1. **Phytophagy (herbivory)**

includes leaf chewing, sap sucking, seed predation, gall induction, and mining the living tissues of plants concerning xylophagous (wood-eating) insects that feed on live trees.

2. **Pollination**

The second category of interactions is important to plant reproduction and involves mobile insects that transport pollen between conspecific plants (pollination) or seeds to suitable germination sites (myrmecochory). These interactions are mutualistic because the insects obtain food or some other resource from the plants that they service.

3. **Coevolution**

Reciprocal interactions over evolutionary time between phytophagous insects and their food plants, or between pollinating insects and the plants they pollinate, have been described as coevolution.