
Converging strategies in plant-manipulating insects: insect-induced effects on plants and possible mechanisms used by leaf-miners to manipulate their host-plant

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Abstract

Gall-inducing insects are iconic examples in the manipulation and reprogramming of plant development, inducing spectacular morphological and physiological changes of host-plant tissues within which the insect feeds and grows. Despite decades of research, effectors involved in gall induction and basic mechanisms of gall formation remain unknown. Recent research suggests that some aspects of the plant manipulation shown by gall-inducers may be shared with other insect herbivorous life histories. The ability of leaf-mining insects to manipulate their host plant physiology asks whether leaf-miners can also be considered to be plant reprogrammers.

Our results on the *Malus domestica/Phyllonorycter blancardella* plant-leaf mining system illustrate similarities and contrasts of metabolic and morphological effects induced on plants by gall-inducing and leaf-mining insects. This leaf-mining insect creates an "optimal" nutritional micro-environment through cytokinin production by their endosymbiotic partners. This symbiotic association impacts not only nutrient acquisition but also the feeding behavior of leaf miner insects. The correlation between the presence of the endosymbiotic bacteria *Wolbachia* and the plant manipulation suggests that insect bacterial symbionts most probably played a major role in the evolution and/or radiation of the endophagous feeding mode.

Keywords: Plant manipulation, effectors, converging strategies, insects

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