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The enemy hypothesis: correlates of gall morphology with parasitoid attack rates in two closely related rose cynipid galls

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Abstract

We tested the enemy hypothesis for gall morphology on a model system comprising two *Diplolepis* rose gall wasp species and their associated parasitoids. The enemy hypothesis predicts both that gall traits will influence parasitoid attack rates within species, and that galls with contrasting morphologies will support different parasitoid communities. This hypothesis is supported by studies at both intraspecific and broader taxonomic levels (i.e. between genera), but patterns remain to be explored in closely related species. Our aims were to explore the relationships between aspects of gall morphology (number of larval chambers, overall gall size and thickness of the gall wall) in each of *Diplolepis mayri* and *D. rosae*, and to explore correlations between these traits and both the presence/absence (=incidence) and attack rates imposed by parasitoids. We found in both galls that chamber number is positively correlated with gall size. In galls of *D. mayri*, parasitoid incidence was negatively correlated with thickness of the wall of the larval chamber, but there was no significant correlation between parasitoid attack rates and overall gall size. In *D. rosae* galls, parasitoid incidence was positively correlated with chamber wall thickness, but parasitoid attack rates were negatively correlated with gall size, suggesting that selection may favour the induction of galls containing more larval chambers. These results confirm that gall extended phenotypes can significantly influence enemy attack rates, consistent with the 'enemy hypothesis'. Further, differences in gall morphology between the two *Diplolepis* species may underlie differences in their associated parasitoid communities – further research is required to test this hypothesis.

Keywords: differential adaptation, *Diplolepis*, gall morphology, parasitoid attack probability, parasitoid attack rate

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Introduction

Plant galls are formed by plant tissues that feed and protect the inducing organism as a result of active growth and differentiation (Stone & Schönrogge, 2003). Cynipid galls (Insecta, Hymenoptera) show high diversity in morphological traits including external structures and numbers of larval chambers (locularity). Cynipid galls are good examples of extended phenotypes; the inducers control the whole process of gall formation at the expense of the plant (Crespi *et al*., 1997; Stone & Schönrogge, 2003; Bailey *et al*., 2009), and gall morphologies are characteristic of the inducer species rather than

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