**Insect egg-killing: a new front on the evolutionary arms-race between brassicaceous plants and pierid butterflies**

## **Abstract**

Evolutionary arms-races between plants and insect herbivores have long been proposed to generate key innovations such as plant toxins and detoxification mechanisms that can drive diversification of the interacting species. A novel front-line of plant defence is the killing of herbivorous insect eggs. We test whether an egg-killing plant trait has an evolutionary basis in such a plant–insect arms-race. Within the crucifer family (Brassicaceae), some species express a hypersensitive response (HR)-like necrosis underneath butterfly eggs (Pieridae) that leads to eggs desiccating or falling off the plant. We studied the phylogenetic distribution of this trait, its egg-killing effect on and elicitation by butterflies, by screening 31 Brassicales species, and nine Pieridae species. We show a clade-specific induction of strong, egg-killing HR-like necrosis mainly in species of the Brassiceae tribe including *Brassica* crops and close relatives. The necrosis is strongly elicited by pierid butterflies that are specialists of crucifers. Furthermore, HR-like necrosis is linked to *PR1* defence gene expression, accumulation of reactive oxygen species and cell death, eventually leading to egg-killing. Our findings suggest that the plants’ egg-killing trait is a new front on the evolutionary arms-race between Brassicaceae and pierid butterflies beyond the well-studied plant toxins that have evolved against their caterpillars.

**Keywords**

coevolution, counter adaptation, egg deposition, hypersensitive response, induced plant defences, plant toxins, specialist herbivores