Biological control in a changing world: How climate affects host-parasitoid dynamics

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Climate change is expected to affect the abundance, distribution and availability of predators that are important for maintaining pest suppression. Moreover, higher temperatures and increased climatic variability are expected to induce differential responses from predators and their prey, with different trophic levels responding differently. Using manipulative lab experiments and field observations, we examined the differential response of a model host-parasitoid system to two climate variables: temperature and drought. The mechanisms affecting predator-prey dynamics were first examined using controlled lab experiments incorporating both climatic drivers. We examined parasitoid fitness, longevity, and development rates and found that parasitoids responded differently when exposed to each climatic variable in isolation compared to the interaction of both variables at once. Although temperature and drought both showed positive effects on parasitoids in their ability to control aphid populations, these drivers, when expressed in concert, had an antagonistic effect, highlighting the importance of studying the interactions between various climate change drivers rather than just their singular effects. Additionally, field results showed that temperature had a positive effect on aphids, parasitoids, and higher-level hyperparastoids. Although temperature positively affected aphid and parasitoid abundance, hyperparasitism rates also increased, partly offsetting the benefit to parasitoids, which suggests that higher levels may impede predictions of predator-prey interactions. Overall, in the absence and presence of predators, both temperature and drought had a positive effect on pest abundance, suggesting that predicting future pest outbreaks will be difficult.