Predicting insect pest status under climate change scenarios: combining experimental data and population dynamics modelling

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Abstract

Climate change could profoundly affect the status of agricultural insect pests. Several approaches have been used to predict how the temperature and precipitation changes could modify the abundances, distributions or status of insect pests. In this article it is demonstrated how the use of simple models, such as Ricker's classic equation, including a mechanistic representation of the influence of exogenous forces may improve our predictive capacity of the dynamic behaviour of insect populations. Using data from classical experiments in population ecology, we evaluate how temperature and humidity influence the density of two stored grain insect pest, *Tribolium confusum* and *Callosobruchus chinensis*, and then, using the A2 and B2 scenarios proposed by the Intergovernmental Panel on Climate Change and the previous modelling, we develop predictions over the future pest status of *T. confusum* along South America austral region, and specifically for eight cities in the continental Chilean territory. *Tribolium confusum* and *C. chinensis* show qualitatively different responses to the exogenous forcing of temperature and humidity, respectively. Our simulations predict a change in the equilibrium density of *T. confusum* from 10 to 14% under the moderate B2 scenario and 12 to 22% under the extreme A2 scenario to the period, 2071–2100. Both results imply a severe change in the pest status of this species in the southern region. This study illustrates how the use of theoretically based models may improve our predictive capacity. This approach provides an opportunity to examine the link between invasive species and climate change and how new suitable habitat may become available for species whose niche space is limited in some degree by climatic conditions. The use of different scenarios allows us to examine the sensitivity of the predictions, and to improve the communication with the general public and decision-makers; a key aspect in integrated pest management.