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# Models vs. experiments to predict crop losses from insects

In their Report "Increase in crop losses to insect pests in a warming climate" (31 August, p. 916), C. A. Deutsch *et al.* use expected effects of higher temperatures on insect metabolic rates to predict increasing rates of consumption by pests and increasing pest population densities. These predictions fail to recognize the complexity and idiosyncratic nature of plant-insect relationships. They do not take into account changes in plant defense, which can respond to both warming and enhanced CO<sub>2</sub> (eCO<sub>2</sub>) in ways that harm some insects and help others (1, 2). Furthermore, Deutsch *et al.* assume that insects will develop predictably faster in response to winter warming. However, warmer winters actually retard development in species whose springtime awakening requires accumulated winter chilling (vernalization) (3). Finally, Deutsch *et al.* assume that pest population dynamics are simple functions of developmental rates. We doubt this is realistic in the presence of temperature-sensitive predators and diseases, and in the context of pest control (4).

Deutsch *et al.* may have oversimplified the problem, but their concern is justified. In an experiment estimating effects of moderate warming on maize in Peru, commercial yield was reduced by more than 90% (far more than Deutsch *et al.*'s prediction), a reduction that was, indeed, ascribed mainly to increased herbivory (5). The question tackled by Deutsch *et al.* is ~~indeed~~ extremely important, but the answers will vary among regions and be specific to each crop-pest interaction. We need experiments that compare yields of target crops in replicated experimental treatments that simulate future conditions of both climate and eCO<sub>2</sub> in the presence and absence of pests. These experiments seem not yet to exist (6). When they do, we should be able to generate better-informed predictions, both of changes in crop yield and of the roles that insect pests will play in those changes.

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