LETTERS

Insects affected by warming temperatures have reduced commercial maize yield in Peru.

Edited by **Jennifer Sills**

Model vs. experiment to predict crop losses

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 temperatures and enhanced CO_2 (eCO_2) 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 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_2 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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10.1126/science.aav4827

Response

Our Report draws attention to a complex but understudied issue: How will climate warming alter losses of major food crops to insect pests? Because empirical evidence on plant-insect-climate interactions is scarce and geographically localized, we developed a physiologically based model that incorporates strong and well-established effects of temperature on metabolic rates and on population growth rates. We acknowledged that other factors are involved, but the ones we analyzed are general, robust, and global (*1*–*3*).

Parmesan and colleagues argue that our model is overly simplistic and that any general model is premature. They are concerned that our model does not incorporate admittedly idiosyncratic and geographically localized aspects of plant-insect interactions. Some local effects, such as evidence that warmer winters will harm some insects but not others, were in fact evaluated in our sensitivity analyses and shown to be minor (see the Report's Supplementary Materials). Other phenomena, such as plant defenses that benefit some insects and threaten others, are relevant but are neither global nor directional. Furthermore, because Parmesan *et al.* present no evidence that such idiosyncratic and localized interactions will outweigh the cardinal and universally strong impacts of temperature on populations and on metabolic rates (*1*–*3*), their conclusion is subjective.

We agree with Parmesan and colleagues that the question of future crop losses is important and needs further study, that targeted experimental data are needed (as we wrote in our Report), and that our estimates are likely to be conservative (as we concluded, but for reasons different from theirs). However, we strongly disagree with their recommendation to give research priority to gathering localized experimental data. That strategy will only induce a substantial time lag before future crop losses can be addressed.

We draw a lesson from models projecting future climates. Those models lack the "complexity and idiosyncratic nature" of many climate processes, but by building from a few robust principles, they successfully capture the essence of climate patterns and trends (*4*). Similarly, we hold that the most expeditious and effective

way to anticipate crop losses is to develop well-evidenced ecological models and use them to help guide targeted experimental approaches, which can subsequently guide revised ecological models. Experiments and models should be complementary, not sequential.

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10.1126/science.aav7405

No conflict of interest in data monitoring

The News Feature "Hidden conflicts?" (C. Piller, 6 July, p. 16) alleges that after serving as a member of a Food and Drug Administration (FDA) advisory panel for a nominal per diem payment, I later received inappropriate payments from the manufacturer (AstraZeneca) for serving on and chairing data monitoring committees (DMCs) overseeing AstraZeneca-sponsored research. Those assertions are inaccurate. The universities conducting clinical trials, not AstraZeneca, compensated DMC members for their time. More important, the OpenPayments database still reports inaccurate payments far in excess of the amount I received from the university. AstraZeneca has acknowledged that it mistakenly reported my name and attributed inaccurate amounts to me in its filing to the database and has agreed to correct these errors.

Serving on a DMC does not involve conducting research, and I did not conduct research on any drug for AstraZeneca after serving on the FDA panel. The DMCs on which I served oversaw the safety of participants enrolled in two postapproval trials funded through research contracts with academic institutions, not contracts with AstraZeneca. Members of DMCs are required to act independently of trial sponsors; they are not investigators. Their responsibility is to ensure the safety of trial participants and scientific integrity of studies to advance research. In this case, the outcomes of both trials were unfavorable to AstraZeneca. Regardless of the outcome, however, I had no financial relationship with the company; the fees, which were nominal, came to me through the university. Serving on a DMC is not a conflict of interest but a public service. My role was to protect the interests of patients, science, and the public.

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10.1126/science.aau9738

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Science **362** (6419), 1122.
DOI: 10.1126/science.aav4827