Letter to the Editor

Effects of Alternating and Mixing Pesticides on Fungal Resistance Buildup—A Reply

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It can be confusing, especially to nonmodellers, when seemingly similar models of a plant disease process yield different predictions. This occurs when the predictions from the model of Skylakakis (2) are compared to those from ours (1). It is, therefore, pertinent to list and examine differences between those models (Table 1) that affect their relative appropriateness.

The use of discrete time steps in our model as opposed to the continuous model of Skylakakis may not greatly affect the model predictions. However, a point that needs to be considered is the appropriateness of using a continuous model for dealing with what, to us, appears to be primarily an event-driven (the event being when spray is applied), discrete process. The ideal may be a continuous process in which the selection pressure for the alternative organisms varies, depending on how recently a spray was applied. However, such a concept introduces a complexity that is disproportionate compared to the simplicity of the other aspects of either model.

A spray coverage factor ("escape factor" in Kable and Jeffery) was not included in the Skylakakis model. We found this to be the single most important parameter in our model. Its effect dominated that of the other parameters and there were several interactions between it and the other model parameters.

TABLE 1. Differences between the Kable and Jeffery (1) and Skylakakis (2) models

Model features	Kable and Jeffery	Skylakakis
Time step	Discrete	Continuous
Spray coverage parameter	Included	Not included
Latent period parameter	Not included	Included

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Skylakakis introduced into his model a latent period parameter, p, which adds an extra feature of reality. He pointed out that the introduction of this extra parameter causes predictions from his model to differ from those of ours.

If the discrete/continuous time-step aspect can be set aside, then each model can be considered to have a subset of parameters from a larger set of parameters that would be used in an ideal model. Because each model contains a parameter not included in the other, different predictions have resulted.

A restriction on the model of Skylakakis is that it is derived from a relationship valid only during the "logarithmic stage" of an epidemic. The relation between basic infection rate (R) and apparent infection rate (r) viz $R = r.\exp(pr)$ does not hold as the epidemic progresses. In fact, as the epidemic progresses, the value of R will approach that of r, sensu Vanderplank (3). Furthermore, in nature, selection for a biocide-tolerant organism usually occurs through several epidemic cycles, not the logarithmic phase of a single cycle.

The approach of Skylakakis is of value since it is a derivation of the model of Vanderplank, whose work on theoretical epidemiology has been most significant. However, the important question is whether this approach can be gainfully used in the theoretical study of pathogen resistance to biocides.

The purpose of this letter is to enumerate and comment on the different approaches, and to provide the reader with a better basis for choosing the model most appropriate for his needs.

LITERATURE CITED

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