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Vineyard View

Pesticide Risk Calculator Debuts

When a winegrape grower decides it is necessary to use a pesticide, he must evaluate which one to use. Considerations include at least the following: level of the pest infestation, efficacy of the material, length of time until harvest, size of the crop, the presence of damage from any other pests—and terms of contracts with winery customers. Many growers are also deeply concerned about the risk the application poses to themselves, their workers and the environment in and around the vineyard.

Until now, most winegrape growers have had no tools to make this risk assessment, other than terms such as "reduced risk" or the warnings on the pesticide label like "Caution," "Danger" or "Restricted Use." I personally do not find these labels all that helpful in terms of risk assessment. Fortunately, a team of scientists, advised by a committee of ag industry stakeholders, has created a web-based software system that growers can use to assess the risk posed by application of any U.S.-registered pesticide—organic or synthetic. The name of the model is PRiME, which stands for Pesticide Risk Mitigation Engine.

Scientists used data from the U.S. Environmental Protection Agency and other sources to create pesticide-risk algorithms.

There are two basic approaches for modeling pesticide impacts: hazard and risk. A hazard model assesses impact based solely on pesticide toxicity. A risk model assesses impact based on both the toxicity and the probability of exposure to the pesticide. The probability of exposure to a pesticide spray is affected by several things, such as re-entry interval, buffer strips, windbreaks, timing of the application (e.g. time of day, time of year), type of spray equipment used and physical characteristics of the field such as soil type, slope and aspect.

The most conservative approach is the hazard model. However, it is not a realistic one. That is because if a non-target is not exposed to a pesticide, then it is not at risk. Moreover, as indicated above, the amount of exposure—and therefore the amount of impact from a pesticide application on a non-target—is affected by many factors that should be considered when measuring the likelihood of real impact. As a result, many feel a pesticide risk model is the most realistic way to measure pesticide impact. The PRiME model is a pesticide risk model.

Who developed PRiME?

PRiME was assembled by a team of scientists and computer programers with exper-

Highlights

- Growers may now use a web-based software system to assess the risk of any U.S.-registered pesticide.
- PRiME calculates the probability of an undesirable impact occurring on humans, birds, earthworms and other non-targets.
- While the ag community has some concerns about the calculator, the author says it is important and valuable for growers.

tise in pesticide risk assessment. The project was funded by the USDA's Natural Resources Conservation Service (NRCS) Conservation Innovation Grant program awarded to the IPM Institute of North America.

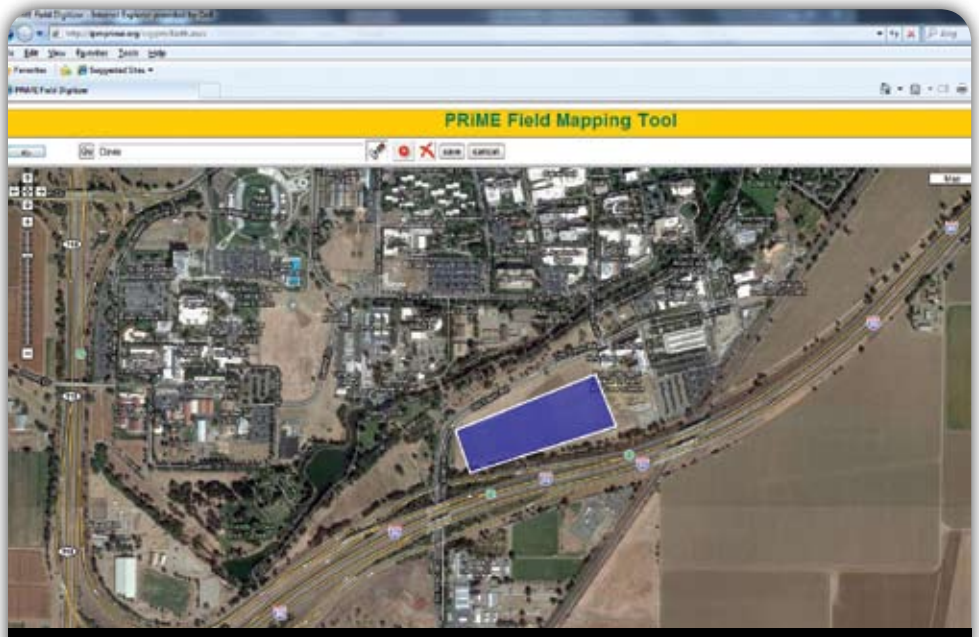
Several years ago, some of these same scientists created a precursor to PRiME—the Pesticide Environmental Assessment System (PEAS)—for the Protected Harvest certification programs, such as the *Lodi Rules for Sustainable Winegrowing* program. Since then, more data have become available, making PRiME more robust and addressing many more non-target organisms. Furthermore, PRiME is being developed with public funds, so it will be available to anyone, whereas PEAS was developed with private money and only available to Protected Harvest clients.

It's important to try and understand what side effects might occur and, if possible, have a tool that can measure their potential risk.

PRiME calculates pesticide risk like this: The user enters the per-acre rate for a particular pesticide application. The model then calculates the probability, expressed as a number from 0 to 1 *(see below)*, of an undesirable impact occurring due to the application on the following non-targets indices: human dietary, human bystander (pesticide inhalation), human dermal, birds, bird reproduction, pollinators, earthworms, small mammals, fish, algae, aquatic invertebrates and volatile organic compounds emission potential.

To make the calculations, the PRiME scientists created algorithms for each index using the latest data from studies that calculated impacts on these various indicators. Where possible, the algorithms have been calibrated based on actual field impact data. Much of this data was generated by pesticide registrants as a part of the application process to register a pesticide with the U.S. Environmental Protection Agency. In essence, each index has its own model, and each was peer reviewed by experts for scientific integrity; results are summarized in white papers posted on the PRiME website.

It is important to note that the risk is calculated for the active ingredient in the pesticide, not for other materials that make



The PRiME Field Mapping Tool is used to evaluate the University of California, Davis, vineyard planted next to the new Robert Mondavi Institute for Wine and Food Science.

up the pesticide's formulation. That is because there is very little data available on the non-target impacts of inert ingredients in most pesticides. In a data-driven model, only the impacts of active ingredients can be calculated.

Using the website

To access PRiME online, create a user name and password. Using PRiME is free, but those who want to save information about fields and pesticide application scenarios will pay a charter membership fee of $24.99 to create an account and store data. All data entered into PRiME are confidential, and will not be shared with third parties.

To begin using the model, name the field where the pesticide has been or will be applied. Google Maps locates the site using the nearest address to the field; from there it's easy to visually locate the field. The user then outlines the field with a drawing tool. The model calculates the area of the field, generates its latitude and longitude location, and goes to an NRCS database, where it retrieves the soil types and slope. These data are used by PRiME to calculate the risk associated with the pesticide application.

Once the target field is mapped and important site information is retrieved, the user enters pesticide application information. Designate the type of spray equipment to be used, select a pesticide, enter the rate per acre and the date of the application. Entering this information is relatively easy: Select your sprayer types, and use the search function to select the pesticide. If the user has electronically stored pesticide application information, PRiME can upload it into the model.

After entering the required application information, PRiME makes the risk cal-

culations. The output for a single application is a vertical graph with the probability of an undesirable impact occurring on the X-axis, expressed as a number from 0 to 1. Zero indicates a 0% probability of an impact; 1 means 100% probability. The number for each index is shown on a bar. The graph also has three color-coded areas. Green indicates minimal risk probability (0-0.1); yellow means moderate risk (0.11-0.5), and red warns of significant risk: 0.5101 *(see accompanying figure at right)*.

Other useful functions

For anyone interested in the risk of pesticide applications to non-targets, PRiME has several highly useful functions. The most obvious is explained above (i.e., seeing the level of risk to 12 non-target indices as a result of application of a pesticide). Another is by varying the number of mitigating factors that affect exposure due to a pesticide application, such as nearness to water, proximity to bystanders, presence of cover crops, windbreaks or hedgerows and reduction in rate per acre. By running PRiME for various scenarios, you can see how the risk is affected by a single mitigation factor or a combination.

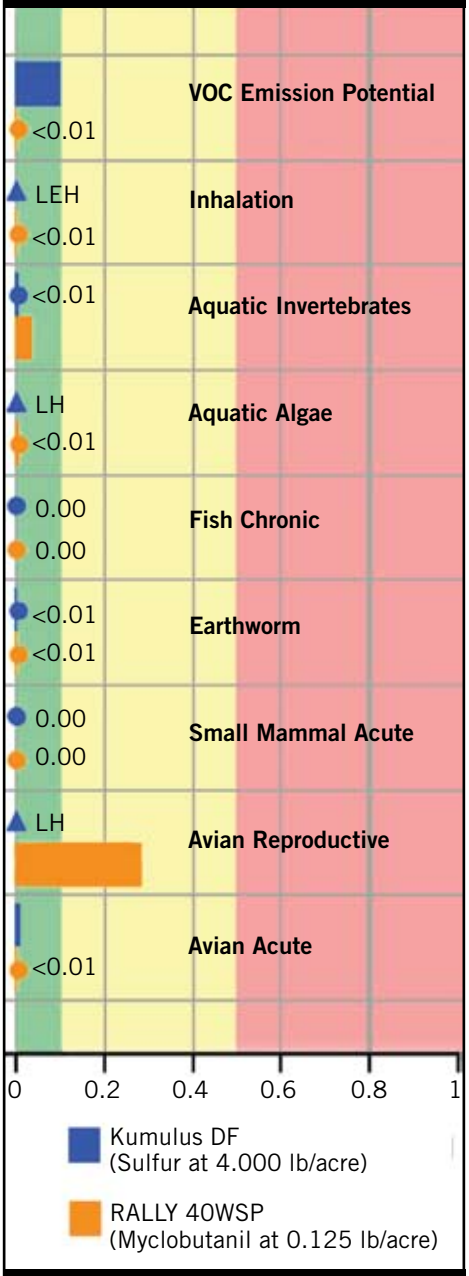
A third option is to run two or more pesticides effective against a particular pest through the program for a side-by-side comparison of the risks each entails *(see accompanying figure at right)*. Finally, you can look at an entire season's pesticide application scenario for a field to calculate the cumulative risk to each index.

The Beta version of PRiME is available online. This version does not have the human dietary, inhalation and pollinator indices, nor does it have the mitigation factors discussed above. These will be available for the fall 2010 release of PRiME.

One challenge with using PRiME is that it cannot "roll up" the risk measures for all 12 indices into one summary number. The risks for each index are not mathematically additive, and risk for a given index is not linearly related to application rate. Also, the scientists behind PRiME believe that such a "roll up" hides valuable information that could be used by the grower to achieve effective mitigation. This makes summarizing the results of PRiME for an entire season's applications cumbersome.

The PRiME team is currently working on developing some useful ways to summarize the model results for a season's sprays. One possibility that would enable tracking of risk during several seasons is to tabulate the number of sprays in each season, when one or more of the 12 indices was in the high-risk red zone, to see how this number varies from year to year.

Using PRiME to Compare Side Effects



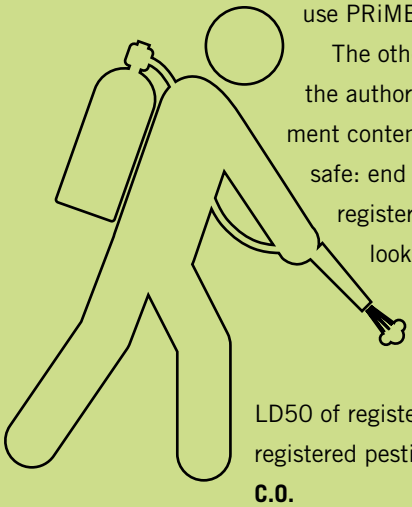
PRiME output compares a treatment of 5 lbs/ac Kumulus DF to 5 ozs/ac Rally 40WSP. (LH means low hazard. LEH means low hazard & low exposure.)

Importance of side effects

I am frustrated at times with some people's inability to deal with pesticides the way we deal with other chemicals. Take medicines for example: By law, drug companies must list any significant side effects on the label or in advertising. Some of them sound horrific to me, and hearing about them on

Two concerns about PRiME

Some stakeholders in the ag community have expressed concerns about the development of PRiME. Two are worth mentioning here: PRiME measures only pesticide risk, but a grower's decision of which pesticide to use is based on a range of factors including efficacy of available materials, economic threshold of the pest, presence or absence of natural enemies, pesticide resistance management, price of the crop, crop quality and so forth. The concern is that some groups will consider only the PRiME output when deciding if growers are "doing the right thing." It is therefore incumbent upon all of us who use PRiME to be very clear about its intent and limitations.



The other concern is that the existence of PRiME undermines the authority of the U.S. EPA to register pesticides. This argument contends that if EPA registers a pesticide, it is considered safe: end of story. The problem with this argument is that not all registered pesticides have equal impact on non-targets. If you look at straight toxicity as expressed by the level of a pesticide-active ingredient to kill half of a laboratory test animal population (LD50) measured in milligrams of active ingredient to kilograms of test animal, the LD50 of registered pesticides varies more than 1,000-fold. Clearly, registered pesticides vary greatly in toxicity and therefore risk.

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radio or TV ads makes me wonder why anyone would use these drugs—yet people gobble them up by the thousands. Listing the side effects does not seem to significantly affect sales.

It shouldn't surprise anyone that when pesticides are applied to a field, there may be side effects. Anything we put on our fields can have side effects, whether the additive is water, fertilizer, compost or compost tea. It's important to try and understand what these side effects might be and, if possible, have a tool that can measure their potential risk of occurring and what practices can offer possible mitigation. In my opinion, that is why PRiME is going to be so valuable. Growers can use it to help assess what potential side effects might occur when they apply a particular pesticide—and how to mitigate them. W&V

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