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The Value of Plant Disease Early-Warning Systems

A Case Study of USDA's Soybean Rust Coordinated Framework

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Early-warning systems for plant diseases are valuable when the systems provide timely forecasts that farmers can use to mitigate potentially damaging events through preventative management. For example, soybean rust (SBR), a soybean fungus which entered the United States in late 2004, posed a new, uncertain, and potentially large threat at the beginning of the 2005 U.S. soybean season. Farmers anticipated markedly reduced soybean yields on fields infected with SBR, but with sufficient notice, they could treat the fields in advance with preventative fungicides, a costly, but prudent, measure.

What Is the Issue?

In 2005, USDA developed an early-warning system that provides real-time, county-level forecasts of soybean rust. This system provides farmers, crop consultants, and others with interests in the U.S. soybean crop timely forecasts of SBR infestations that could sharply reduce soybean yields. Forecasts and recommended management activities are provided via a publicly accessible website, the first time a web-based system has been used for this purpose. The information on the website is developed through a large coordinated framework that involves many government and nongovernment organizations that regularly collect samples from fields, test them, and incorporate them into forecasting models. But how valuable is the information provided by the framework? This question has become particularly salient in light of modest outbreaks of SBR in 2005. This study uses the SBR system as a case study to determine the effectiveness of such early-warning systems. The answer will aid decisions on future investments in this system and perhaps others like it.

What Did the Study Find?

The value of the framework's information depends on many factors, particularly farmers' perceived risk at the beginning of the season of SBR infection and the accuracy of the system's forecast. These factors cannot be precisely quantified, but our analysis shows that, although the value of information from the system varies somewhat geographically, overall the system's value has been substantial. Even if forecasts are poor, resolving only 20 percent of SBR infection uncertainty for all fields planted with soybeans, the system's value is an estimated $11 million in farmer profits in the first year. If forecasts resolve 80 percent of infestation uncertainty, the estimated value is $299 million. Our analysis suggests that the value of the information in 2005 likely exceeds reported costs of developing the information.

The study also analyzes two more subtle features that affect estimated information values: anticipated price shocks in the event of large rust outbreaks and soybean farmers' aversion to risk. We found that both of these factors reduce the largest estimated values and increase the smallest

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ones, but the magnitude of the effects are modest relative to the perceived forecast quality. The large potential benefits of the framework suggest that similar programs for other crop pests can be cost effective if, as in the case of soybean rust, preventative action can strongly mitigate damages in the event an outbreak.

How Was the Study Conducted?

The study applies conceptual methods from decision science to evaluate how much expected profits increase if farmers are able to fine-tune their rust management decisions in response to SBR forecasts. These methods are combined with USDA data on historical soybean yields, data from USDA's Agricultural Resource Management Survey, estimated soybean rust damages from Brazil and Paraguay, and spore dispersion estimates based on an aerobiology analysis and historical experience with wheat stem rust. Information values were calculated over a broad range of assumptions because some of the parameters were not estimable and some parameter estimates were uncertain.