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The Establishment of a National Pest Information Platform for Extension and Education

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Abstract

Many millions of US soybean acres that would have received at least one fungicide application remained untreated for soybean rust in 2005 due to information disseminated through the US Department of Agriculture Soybean Rust Information System website. The information provided by the system increased US producers' profits by between $11 and $299 million at a low cost of between $2.6 and $5 million (8). This savings and the positive environmental implications of not spraying millions of acres with fungicides demonstrates the value of a coordinated national pest management framework and stimulated the development of the 2006 Pest Information Platform for Extension and Education.

Introduction

The application of advanced information technologies (IT) to the soybean rust threat has enabled the deployment of a pest information system with a level of utility and credibility never previously achieved for an invasive agricultural pest in the US (8). As a result of this success, government administrators, researchers, industry representatives, and producers are employing the same template to launch a national Pest Information Platform for Extension and Education (PIPE) (10). In 2006, PIPE will focus on established pests of soybean and other legumes under the direction of the US Department of Agriculture (USDA) Regional Integrated Pest Management (IPM) Centers. A diverse array of pest information systems in the US provide growers with valuable information for managing plant diseases, insect pests, and weeds at local, regional, and national scales. The vision for PIPE is to enhance the use of these decision support systems, facilitate development of additional IPM programs, help growers document their management actions for crop insurance claims, and provide a structure that will enable quick response to threats from exotic pests.

PIPE integrates people and computers, distributed throughout the nation, who are networked and facilitated by "state-of-the-art" IT. It supports observation networks, diagnostic laboratories, data management, modeling, interpretation, and the dissemination of timely information on a well-integrated platform to help farmers combat plant diseases, insect pests, and weeds. An important philosophical underpinning of PIPE is that extension and education activities for both integrated pest management and risk management associated with crop insurance should proceed hand-in-hand. PIPE is built on the existing USDA, university, and state departments of agriculture infrastructures and benefits from an informal partnership with industry.

Why is PIPE Needed?

The primary objective of an effective pest information system should be to provide extension agents, consultants, growers, and other clientele with effective decision support for managing agricultural commodities (6). This extends from the diagnosis of pest problems to the selection and timing of pest control practices that maximize economic return, while minimizing risks to human health and the environment. The National IPM Roadmap seeks to accelerate progress in the adoption of IPM practices (11), and PIPE integrates within this process to deliver the information that growers need to advance their pest control systems. PIPE empowers extension specialists by providing extensive and efficient access to observations, model output, pest management information, and guidelines from other states, as well as a platform to rapidly communicate their interpretation of this information to growers on maps and in text. In 2006, PIPE will help growers document their "good farming practices" for crop insurance purposes (1,13), and it will provide information on the ways in which risks are reduced in commodities that make maximum use of high quality information, delivered in a timely manner.

Qualities, Components, and Organizational Layers of PIPE

PIPE was carefully constructed to maximize a set of qualities deemed integral to the success of large scale pest information systems:

- *Utility* at multiple resolutions from local (farm) to regional or national.

- *Credibility* with growers, industry, researchers, and administrators. PIPE operations are independent of government and businesses that sell agricultural products. PIPE operates under a Code of Ethics that maintains anonymity of private grower production records, but also serves the research community with data that can be used to understand and improve pest management and production practices (7). It continues to be validated in ways that allow adopters to have direct access to information regarding its decision support efficiency.

- *Flexibility and adaptability* to accommodate new data, partners, analyses, information technologies, and the wide array of existing IPM structures ranging from private consultants to extension educators and specialists to large corporate management systems.

- *Affordability* with a cost structure that is economical to the end user yet contains value as a component of a total crop management.

- *Sustainability* to stimulate investment by industry, researchers, and administrators.

- *Consistency and Familiarity* to ensure frequent information access by growers.

Annual workshops for researchers, administrators, growers, and industry representatives provide a mechanism for performance assessment of PIPE activities in each "quality" area and an evaluation of plans for future years.

The components of the platform and flows of information within PIPE are depicted in Fig. 1. Knowledge bases and research provide the foundation for the system. Field observations are channeled through standardized internet portals into a national computer database. These reports are immediately available to researchers throughout the country who add value to the observations through modeling and analysis. PIPE provides a platform for extension specialists, researchers, and administrators to view observations and model output on maps. Specialists communicate interpretations, management guidelines, and other relevant materials to growers and industry agents through the internet using standardized state-of-the-art IT tools. Feedbacks (gray arrows) between system components facilitate responses by observers to needs of researchers for data to run models and conduct other analyses as well as responses by researchers and observers to the needs of specialists for information to inform their grower and industry constituencies.

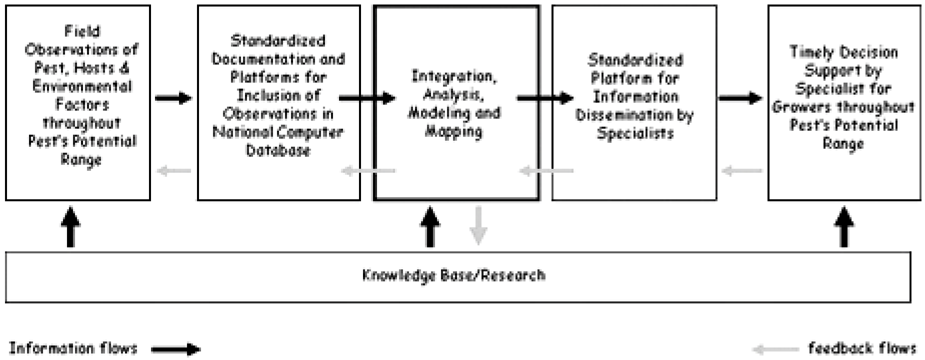

Fig. 1. PIPE components and information flows.

Effective pest information systems channel flows of information from field observations to the grower through organizational layers, adding value during the process. In PIPE, the layers and their functions are:

- *Scout/Sample.* Plant, pest, weed, and disease data are collected by research oriented sentinel plot, and other public and private monitoring networks. These data are supplemented by observations from commercial fields and natural environments by specialists, scouts, industry workers, producers, and other qualified individuals.

- *Diagnostics.* USDA, National Plant Diagnostic Network (NPDN), and state laboratories confirm observations of diseases and pests adding credibility to the system.

- *Data Management.* Tasks include submission of field observations, transmission of data among various government and private agencies, integration of numerous types of data from multiple sources, formatting of data for use by researchers to run models and by administrators to address queries, and archival activities.

- *Modeling.* Value is added to data through analysis and modeling.

- *Interpretation.* State specialists integrate field observations and analysis/model products to provide timely commentary and management guidelines for growers. Industry agents fine tune specialist guidelines for their grower customers.

- *Dissemination.* Commentaries and management guidelines are transmitted directly to growers and other users via the internet and indirectly through other media.

To expand PIPE to a wider array of pests, diseases, and weeds, the USDA is funding diagnostic and pest monitoring research to increase the contribution of these activities to IPM decision making (5). These investments should stimulate innovations in remote sensing, other monitoring technologies, and advanced diagnostic techniques (e.g., 2,4,9), and as a result, create a more effective and efficient crop management system nationally.

PIPE Agents and Their Contributions

PIPE has been built on the existing structure of regional IPM centers and state extension specialists. The IPM centers interact with industry to set regional pest priorities while the specialists provide monitoring information as input to databases and interpret observations and model output to provide agricultural producers and industry with decision support for pest management and documentation of management activities. Although much of the initial direction and funding for PIPE has been provided by the USDA, the system is designed to be sustained by industry (Fig. 2). PIPE (black rectangles with white text in Fig. 2) provides a mechanism to channel field observations and diagnostic activities into national databases (large clear arrow on right in Fig. 2). The internet platform and related databasing, mapping, and communications software were created by a team of scientists from Pennsylvania State University and ZedX Inc., an information technology company in Bellefonte, PA. Research funded and/or conducted by USDA agencies including the Cooperative State Research Education and Extension Service (CSREES) and Agricultural Research Service (ARS) as well as Land Grant Universities (LGUs) and Industry provide improved knowledge for interpreting observations, analyzing data, and constructing models (large clear arrow on left in Fig. 2). Industry contributes observations and funding to support monitoring activities (top center in Fig. 2). The USDA Animal and Plant Health Inspection Service (APHIS) coordinates the use of PIPE for invasive species while IPM centers prioritize activities and research associated with pests established in US agricultural regions. The regional IPM centers also help coordinate data-gathering activities and information dissemination through extension specialists and state departments of agriculture (center in Fig. 2). Information to support pest management decisions is disseminated by extension specialists through the national platform directly to growers and indirectly to growers through industry agents (lower center in Fig. 2). The quality and utility of this information is increased because state extension specialists have real-time access to maps of pest distributions, visual depiction of predictive model output, and management commentaries and guidelines from colleagues in other states. Finally, producers influence scouting and research activities through their grower organizations (bottom in Fig. 2).

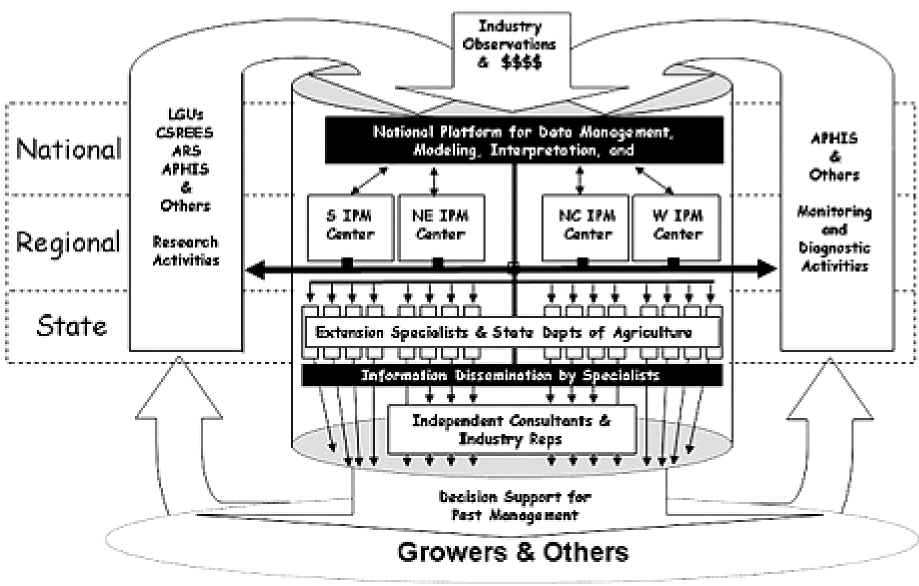

Fig. 2. PIPE agents and their contributions. Abreviations: LGUs = Land Grant Universities; CSREES = Cooperative State Research Education and Extension Service; ARS = Agricultural Research Service; APHIS = Animal and Plant Health Inspection Service; S IPM Center = Southern Integrated Pest Management Center; NE IPM Center = Northeast Integrated Pest Management Center; NC IPM Center = North Central Integrated Pest Management Center; and W IPM Center = Western Integrated Pest Management Center.

Sustaining the PIPE

The November 2004 discovery of *Phakopsora pachyrhizi*, the causal agent of soybean rust, throughout nine southeastern states inspired an unprecedented level of cooperation among USDA agencies, state departments of agriculture, universities, industry, and grower organizations to develop a coordinated framework to help growers manage this potentially devastating disease (12). Central to this effort was the development of the USDA Soybean Rust Information System to integrate monitoring, diagnostic, databasing, modeling, forecasting, mapping, and information dissemination activities associated with this pathogen. In 2005, a year with low rust infection, the management decision support provided by the USDA Soybean Rust Information System website increased US producers' profits between $11 and $299 million ($0.16 to $4.12 per acre).

In 2005, APHIS funded the coordinated framework for soybean rust surveillance and monitoring, predictive modeling, web-based dissemination of information to stakeholders, development of management (fungicide) guidelines, and communication and outreach (10). CSREES and ARS contributed substantially in the areas of diagnostics and research. Approximately $800,000 was spent by APHIS on sentinel soybean plots in 35 states and Puerto Rico with the United Soybean Board (USB) and North Central Soybean Research Program (NCSRP) contributing an additional $287,000 (8). APHIS also transferred $180,000 to CSREES to support mobile survey units for dispatch to states to help quickly identify the disease and report surveillance data (10). Approximately $600,000 was spent on identifying soybean rust by NPDN laboratories (8). In addition, APHIS spent $210,000 to construct and operate the USDA Soybean Rust Information System web site (10). Roberts et al. (8) estimated that the total cost of the coordinated framework for soybean rust was between $2.6 and $5 million.

Realizing the success of the 2005 IT approach to coordinating decision support for managing soybean rust, the USDA Risk Management Agency (RMA), CSREES, and APHIS reached an accord to maintain and expand the system for 2006. Since *P. pachyrhizi* had become established in North America, the soybean rust information system no longer fit within the mission of APHIS. In September 2005, RMA provided $2.4 million to CSREES through an interagency agreement to track the spread of soybean rust in 2006 and to create the Pest Information Platform for Extension and Education to provide producers with information about additional legume pests and diseases (11). CSREES will support a national sentinel plot monitoring network, diagnostic laboratory identification activities, mobile in-season scouting of commercial fields, rainwater and dry deposition spore trapping networks, winter sampling for infected kudzu, workshops for evaluating PIPE, and a variety of educational activities directed at extension agents, industry, and growers. The Southern Regional IPM Center accepted the challenge of coordinating the operation of the 2006 PIPE. To insure a smooth transition in leadership, APHIS agreed to continue funding the modeling effort, database activities, and the expansion and operations of the PIPE web site in 2006. In support of the USDA effort, the USB and NCSRP agreed to fund additional sentinel plots and provide support for the dissemination of educational materials to growers.

The challenge now is to establish a basis for sustaining the PIPE. The system couples extension and education activities for both integrated pest management and risk management associated with crop insurance. PIPE enhances the role of extension specialists in IPM by providing near real-time access to observations, model output, pest management information and guidelines from other states, as well as communication tools for dissemination their interpretation of this information to support pest management decision making by growers. Initially, some specialists were apprehensive about potential overlap between the soybean rust platform and existing state extension information networks; however, most specialists now believe that PIPE provides them with information that truly enhances their extension and education programs (3).

The platform is designed to accommodate agricultural commodities grown at spatial scales that range from small regions to entire continents. In the short-term, the RMA is funding PIPE to enhance education and documentation for crop insurance purposes, CSREES is championing the system as a national effort to enhance the adoption of IPM practices, and APHIS is supporting the platform in anticipation of using it again to respond quickly to threats from exotic pests. However, in the long-term, PIPE is only viable if there is economic return to growers from applying advanced IT for scouting, diagnostics, data management, modeling, interpretation, and/or rapid dissemination of information.

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