A Holistic Approach to Understanding the Soybean Rust Issue

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Abstract

Our objective is to examine the consequences of soy rust to the U.S. agriculture in the next five years, looking at the problem holistically, including its several dimensions, such as detection, treatment, market mechanisms and institutional incentives (insurance, subsidies, etc).

This research is part of a larger effort involving critical infrastructure protection, including agriculture, energy, water, insurance, commerce, transportation, and others. Key to this research program is examining interdependencies within and across infrastructures; for example, between soybeans and corn, between grains and animals, between agriculture and industry (e.g. chemical).

A definitive solution to the soy rust problem may take five to ten years, and it will involve developing a genetically resistant soybean. This hinges on the assumption that the needed strain is available in a gene bank. Otherwise, it has to be genetically modified. In the mean time, the disease has to be managed to avoid significant losses. To tackle the soy rust problem, as a subtype of the more generic issue of crop and animal diseases, it is necessary to connect different pieces of the puzzle to see what can be said about the whole problem – What piece of the puzzle carries the leverage to adequately contain and manage the disease? What interactions between the pieces is key to understanding potential solutions to this problem?

This poster provides a brief overview of the programmatic, technical and methodological components of our study, and presents an opportunity for exchange and collaboration in this cross-boundary assessment of the soy rust issue.

Programmatic overview

The Critical Infrastructure Protection Decision Support System (CIP/DSS), funded by DHS, provides insights to help formulate effective strategies for reducing the impacts of disruptions to critical infrastructure systems. The program draws upon a suite of interconnected simulation models for assessing the consequences of a wide range of disruption scenarios and identifying leverage points within these systems.

The goal is to use the simulation laboratory to examine infrastructure interdependencies, vulnerabilities and threats, prioritizing issues of concern, formulating protective measures, and performing tradeoffs between alternative courses of action. CIP/DSS supports development and analysis of scenarios, and facilitates stakeholder analyses and training exercises.

Technical overview

A holistic perspective on managing the soybean rust issue includes among others: surveillance, diagnostics, fungicide application and efficacy, soybean market economics (substitution issues, globalization), and the institutional economics (subsidies, insurance, etc). A comprehensive taxonomy of issues identified 100+ items of concern dealing with the physics of the pathogen and the remedy, the economics of the infrastructure, and vulnerability and policy issues raised by current events.

For more information regarding the technical aspects of this work please contact Paul Kaplan and Steve Conrad.

Methodological overview

Effective group decision support systems require a combination of astute analysis and skillful facilitation:

System dynamics modeling and simulation enables structural understanding and explanation of complex dynamic behaviors. The models are bounded representations of real systems. They are used to explore scenarios, evaluate policy alternatives, examine risk and uncertainty, and project future trends. SD analyses include circular causality (feedback) and nonlinearities.

Group modeling is an approach involving facilitation and reflection to elicit and integrate expert-based insight of fragmented and interdependent systems. It is a process for drawing model boundaries to capture essential elements needed to address shared interests and concerns across stakeholders.

For more information regarding CIP/DSS please contact Sharon Deland.

Opportunity presented

The American agricultural community – growers, researchers, educators, crop consultants, agribusiness, industry, the USDA, and other leaders in government – demonstrated response capability in dealing with the imminent challenge presented by the introduction of soybean rust in the United States. The informal and institutional communications and working relationships in this network serves as a role model for other industries in its organization, knowledge, and exploitation of resources and technology for mutual benefit.

However, the fragmentation of knowledge resulting from sub domain expertise begs for a tool and a process for knowledge integration. We propose taking a holistic perspective on the soy rust issue to tackle the problem of managing and controlling it. This could take the form of putting the whole puzzle together or studying certain specific interactions. For example, could a disruption in chemical inputs cripple the soybean harvest and export trade? What endogenous factors could account for a gap between fungicide supply and demand? Remember, this actually happened with the flu vaccine!

We invite partnerships to investigate the soy rust problem from a multiaxected perspective. We especially welcome interest in looking at concerns crossing stakeholder boundaries, particularly drawing upon the experts themselves to quickly assemble a model to examine consequences, interactions, unintended effects, addressing what-if questions, identifying robust management strategies to deal with the problem, and finding effective solutions.