Soybean Rust Aerobiology Model: 2005

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Aerobiota Transport Process Model

Horizontal Transport

Earth’s atmosphere

Takeoff and Ascent

Pre-conditioning

SOURCE AREA

Descent and Landing

Impact

DESTINATION AREA
Turbulent Transport and Dilution in the Atmosphere

Survival of Spores while Airborne

Conceptual Model of Soybean Rust Transport Process

Synoptic Scale Airflows
Govern Transport Direction and Speed

Ultraviolet Radiation

Temperature and Relative Humidity

Turbulent Diffusion and Wind Shear
Govern Dilution

Dry Deposition Due to Wind and Turbulence

Wet Deposition Due to Washout by Precipitation

Vertical Distribution of Spores in Canopy

Canopy Density & Structure

Wind & Turbulence

Time of Spore Release

Soybean Plant Growth

Stage of Disease

Weather

Escape of Spores from Canopy

Spore Production

Deposition of Spores into a Soybean Crop

Colonization of Soybean Crop
Conceptual Model of Soybean Rust Transport Process

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Temperature & Leaf Wetness

Soybean Crop Growth Stage
As of August 24th, several localized moderate areas of transport are predicted in LA, AR, MS, AL, and GA. The areas surrounding these moderate areas are mostly light to very light.
Up to August 24th, wet deposition of spores is light to moderate in GA and AL with another hot spot in LA, MS AR. The areas surrounding these hot spots has mostly light deposition predicted over this period.
This simulation, based on USDA agricultural statistics and other communications, appears to be slightly ahead of the growth stages at most locations. In many locations it is running 1 to 2 weeks ahead of observed.
Modeling: Information for Specialists, Researchers, and Administrators

National Map Commentary (updated: 08/16/05)

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What Did We Learn

Geographic distribution of and number of spores produced in source areas is critical to forecasting.

Caribbean basin was not a significant source region for soybean rust spores in 2005.

Local spread is very complicated. Observations in 2005 revealed that pathogen spread more slowly within Kudzu patches than in infected soybean sentinel plots.

Soybean rust spores are very sensitive to exposure to solar radiation.


In 2005, we had to rely on sentinel plots and mobile scouting for reliable information on soybean rust spread. Clearly scouting in the southern states will be a critical component of the USDA Soybean Rust Information System in 2006. We need both sentinel and mobile scouting during late winter and throughout the growing season.
Research Areas Remaining that are Important to Modeling Effort

Environmental and host influences on spore production

Influence of environmental factors and canopy structure on escape of spores from the canopy

Spatial assessment of disease severity

Wash off by rain during deposition events

Measurements of deposition

Is long range (in time) forecasting applicable to soybean rust prediction
What Will We Improve for 2006

Better Kudzu map?
Sub-grid cell parameterization of source areas for inoculum production
Improve canopy escape function
Add consideration of thermal hydration to survivability function
Include dry deposition
Ensemble approach to transport and local disease modeling