



Plant Diseases

How to read spore forecasting maps

X. B. Yang and Kwang-Soo Kim, Department of Plant Pathology, Iowa State University, and Zaitao Pan, St. Louis University

In the coming season, forecasting or modeling of rust spore movement has been proposed to provide producers with a tool for rust management. There is a possibility of spore maps being used to guide our scouts if the model is implemented. This article addresses two related aspects: (1) how soybean rust spreads from southern overwintering regions to northern soybean production regions; (2) how to read spore forecasting maps that will be posted on the Web to help us scout soybean rust during the coming growing season.

To know the risk, we first should know that **the presence of rust spores does not equal presence of soybean rust disease**. In Brazil, because the soybean rust fungus can overwinter in most soybean production regions (Figure 1), rust spores are present as soon as soybean emerges. But the disease does not necessarily happen all the time. The predicted presence of spores only means that when conditions are good, the disease is likely to attack soybean plants and build up, which takes time.

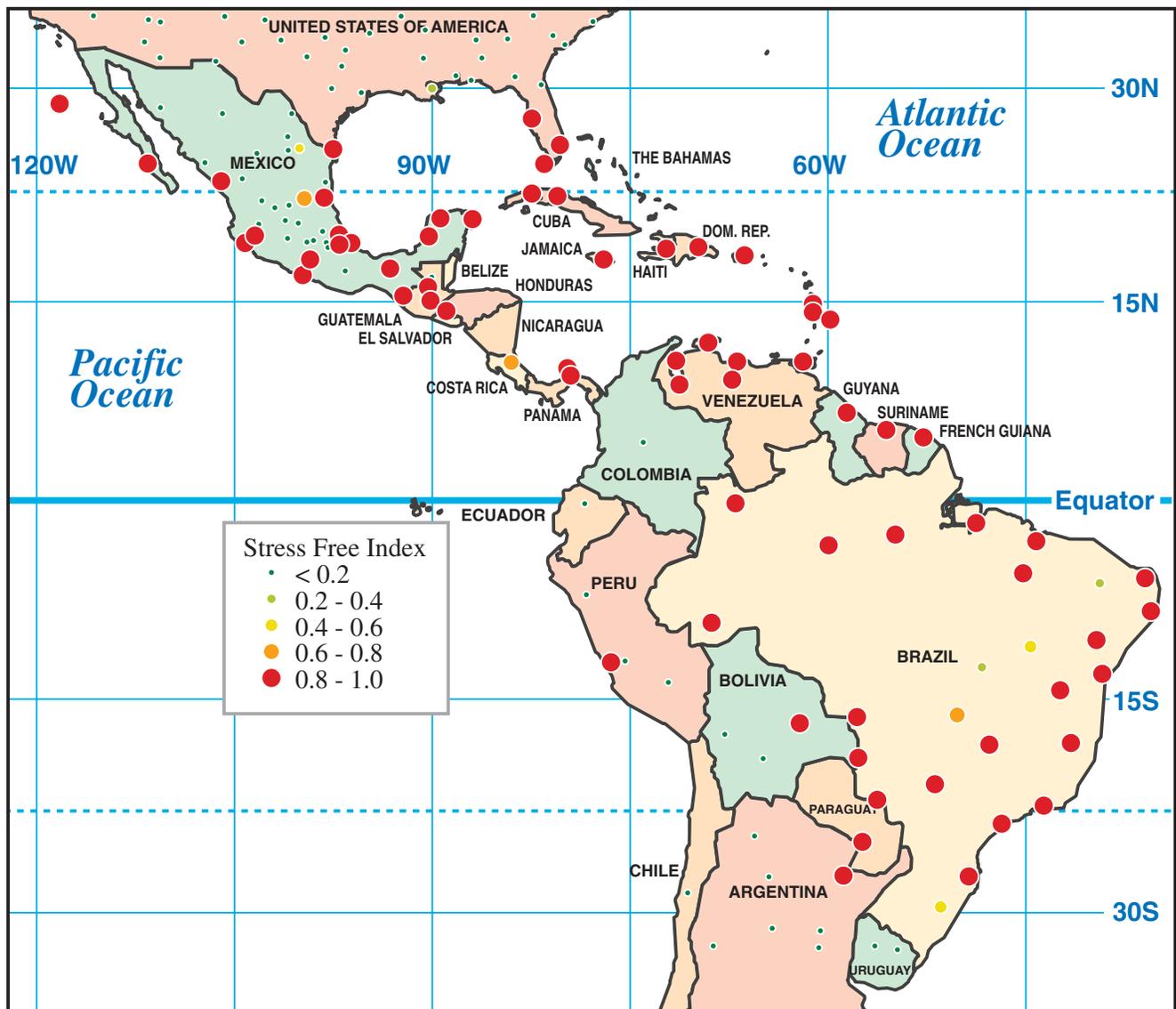


Figure 1. Soybean rust overwinter regions in North, Central, and South America.

Source: Modified from Pivonia and Yang

In the United States, the rust fungus survives farther south in winter and spores may spread north during a growing season. To know the potential movement of rust spores, we developed a method to quantify spore movement using aerobiology and soybean rust epidemiology. The movement of soybean rust from Gulf Coast states to northern soybean production regions is modeled under the worst case scenarios: (1) kudzu in the southern states can be infected as soon as it turns green in early spring; (2) it takes no longer than two weeks for the fungus to establish in kudzu plants and produce a large amount of spores after spore arrival in a region (a rare situation).

Our modeling results show that there are several different pathways during a growing season. One likely pathway of spore movement is shown in the spore maps

(Figure 2). If a large amount of rust spores is produced in early April on kudzu or other susceptible hosts in central Florida, there is a high probability for the spores to reach southern Mississippi as indicated in brown (map A). It can also reach the other areas with a small chance as indicated in blue. Assumingly, after arrival, the fungus takes two weeks to infect kudzu plants and produce spores. Establishment of soybean rust in early spring in Gulf Coast areas, such as southern Mississippi, is critical based on corn leaf blight epidemic experience. When this area becomes a spore production area, the rust fungus produces spores and moves farther north. Spores are likely to reach the northern Arkansas soybean production region or Kentucky (map B) in mid-May. Because soybean is yet to emerge or just emerges in mid-May, rust can mainly attack kudzu plants there.

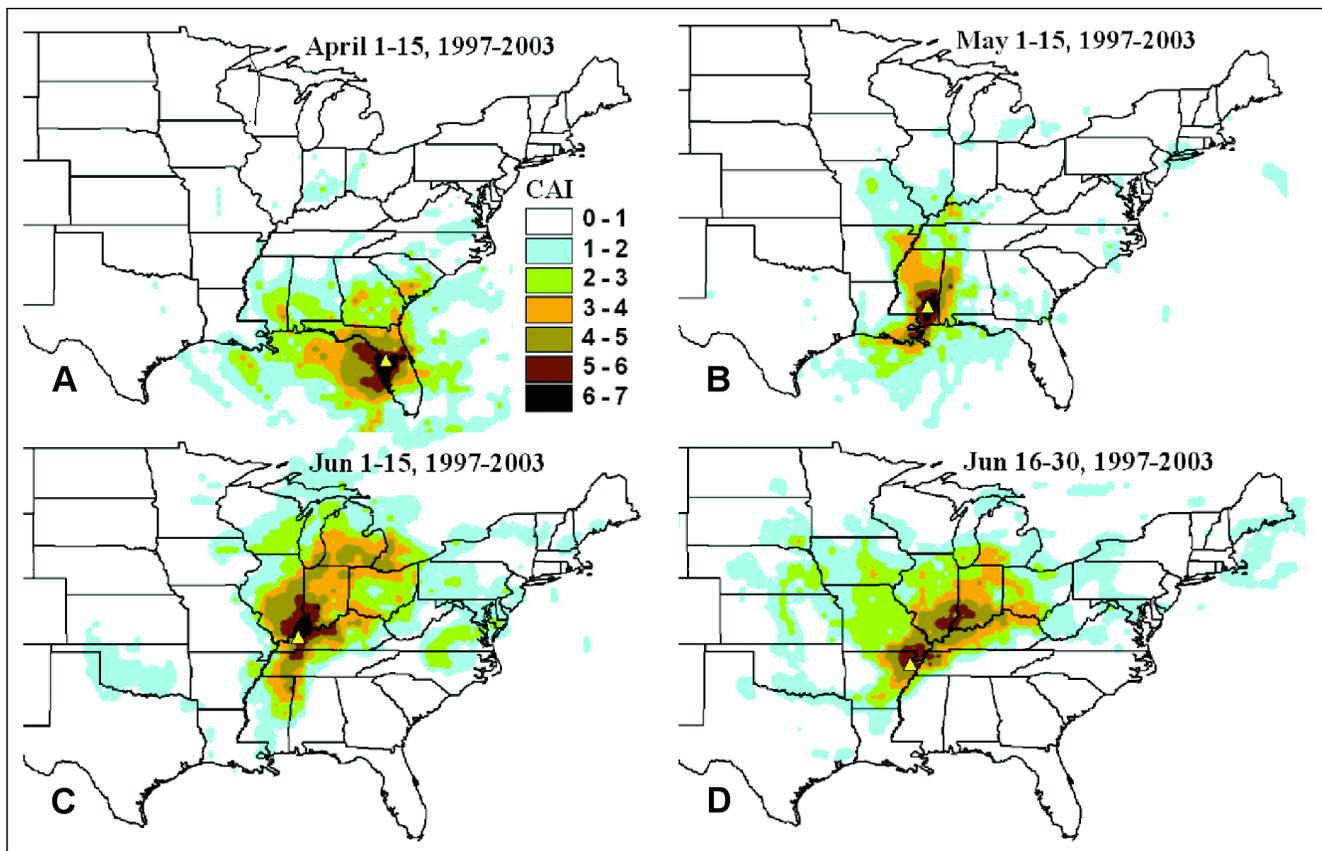


Figure 2. Computer-projected soybean rust spore pathways. Spores do not necessarily mean rust. Potential dispersal pathway of soybean rust (*P. pachyrhizi*) from overwintering area to the North Central soybean production regions under worst-case scenarios in which spores are produced in kudzu early in a season. Color code is relative frequency of spore travel: blue = less likely, brown = very likely, yellow triangles = areas of spore source.

Source: Kim, Yang, and Pan

If kudzu plants in Kentucky are infected as early as June and produce many spores, which are two big “ifs,” the spores may move to Iowa in later June (map C). When northern Arkansas becomes a spore production area, spores could spread to major northern soybean production regions in late June (map D). Our simulation results also suggest that spores could be transported to Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota along the “wheat rust pathway,” when soybeans in southern Texas are infected early in a season.

Uncertainty is great. Our results suggest that there are many “ifs” for spores to travel to northern states in a growing season. Kudzu plants have to be susceptible; weather must be favorable to rust fungus infection. When these “ifs” do not become reality under certain conditions, the disease may travel slowly. The earlier the disease occurs in a season, the greater the loss.

Spores do not equal disease. Presence of rust spores in a region does not mean the disease is present

as we learned from Brazilian data. In Brazilian soybean production regions, where spores are present year-round, only 3 percent of rust detections were found before flowering, 25 percent in R1 and R2 stages, 30 percent in R3 and R4, 36 percent in R5 onward. In the United States, if the spores arrive in Iowa in late June, under worst-case scenarios, the disease will not occur unless a period of rust-favorable weather conditions occurs. When the forecast indicates the possible arrival of rust spores, we should intensify our scouting activities. Scouting following a spore forecast helps make timely spray decisions.

X. B. Yang is a professor of plant pathology at Iowa State University. Kwang-Soo Kim is an Iowa State University postdoctoral research associate modeling the spread of soybean rust. Zaitao Pan is an assistant professor of climatology at St. Louis University.

Seasonal timeline for assessing risk of soybean rust

In order to prepare for a possible movement of soybean rust into Iowa, a soybean rust detection program is in place (see “Use the soybean rust Iowa Fast Track System,” page 36). One of the keys to the program is finding the disease in a timely manner, which helps determine when and where to effectively apply fungicides to control the disease. It will be important for producers and their advisers to correctly assess the risk of soybean rust as the season progresses.

Know the timeline

Iowa State University soybean pathologist X. B. Yang outlines the following timeline of steps producers can follow to assess risk of seasonal epidemics:

March

Monitor information on rust outbreaks in Florida and southern Texas—an early indication rust spores would likely move to the Gulf Coast states and north.

April, May, June

Watch for rust occurring in Louisiana, Mississippi, and Alabama, which are potential rust pathways to the North. If outbreaks occur on soybean plants or kudzu in April and May, the spores are likely to reach northern soybean regions as early as July. A rust outbreak in June in the South is important but not as great as that in May or earlier. Also in April and May, check information from the Climate Prediction Center at the National Oceanic and Atmospheric Administration (NOAA), www.noaa.gov/climate.html.

July, August

Critical months. A climate prediction for these months that includes normal to below normal temperatures and normal to higher moisture levels would be suitable for rust occurrence in Iowa, if rust is occurring in Gulf Coast regions.

To learn more about Asian soybean rust and to read Yang’s complete analysis, visit:

www.plantpath.iastate.edu/soybeanrust/node/46.