Evaluation of Potential for Atmospheric Transport of Soybean Rust Spores from Roraima, Brazil and Cali, Columbia to the Continental United States

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(Updated -August 29, 2004. by Magarey and Keever)

This is a preliminary report of soybean rust trajectories from two locations using the HYSPLIT model (Draxler and Rolph 2003; Rolph 2003). The methodology for this analysis is explained in detail in Isard et al. (2004). This analysis will be updated on September 10, 2004. The runs were completed by Thomas Keever of NCSU. The report was requested by Mathew Royer, PDMP-APHIS in response to recent unconfirmed reports of rust in Cali, Columbia and also in light of the recent tropical storms Bonnie and Charlie which may provide a mechanism for rust transport to the United States.

The trajectory analysis does not imply that viable rust spores were transported with air parcels. The transport of viable spores also depends upon source production, survival during transport and deposition at the target site. The vast majority of the airborne spores involved in these hypothetical releases would have been either rendered non-viable because of exposure to UV radiation during transport or washed out of the atmosphere by precipitation before arriving at these destinations. This is especially true for Mexico and the U.S., locations that are far from the South American source regions and for those trajectories that involve tropical cyclones. The heavy precipitation associated with these storms makes it likely that most rust spores would be removed from the atmosphere prior to arrival in the United States. The presence of precipitation at these target destinations that could cause deposition of spores is also not considered in this analysis.

Analysis of data for Roraima, Brazil.

Soybean rust has not been confirmed at this location. Trajectory analysis was requested for this site several month ago and many runs have been achieved. The rapid spread of rust in Brazil makes Roraima a likely candidate source area in the future. Since the ITCZ equatorial zone acts as a barrier for atmospheric transport, Roraima being in the northern hemisphere could be a likely source area for introductions into North America. Trajectory runs were made on 69 days in June, July and August. Each run lasted for a 12 day period and includes launch altitudes of 100m (red triangles), 200m (blue squares), and 500m (green circles). Regional breakdowns are for Central America, the Caribbean, Mexico, and the United States. If any of the three trajectories crosses over or near a target region, then that region was counted (impacted). Of these runs some 16% impacted the United States (Table 1) mostly in the south-eastern United States.

Table 1. Trajectory analysis beginning in Roraima Brazil, 3.9 N and 61.00 W for 69 days in June, July and August 2004

Region impacted by air parcels	Days	Percent
Central America	55	80
Caribbean	16	23
Mexico	22	32
United States	11	16

Nearly all of the Central America trajectories moved in or near the southernmost countries of Panama, Costa Rica, or Nicaragua. Trajectories on August 3, 7, and 8 moved into the Caribbean. The timing appears close for possible interaction with one of the tropical weather systems. The trajectory for August 3 nears the U.S. late in the event and its interaction would be with Bonnie. Events on August 7 and 8 could involve interaction with Charley somewhere in the Caribbean. This is still under investigation.

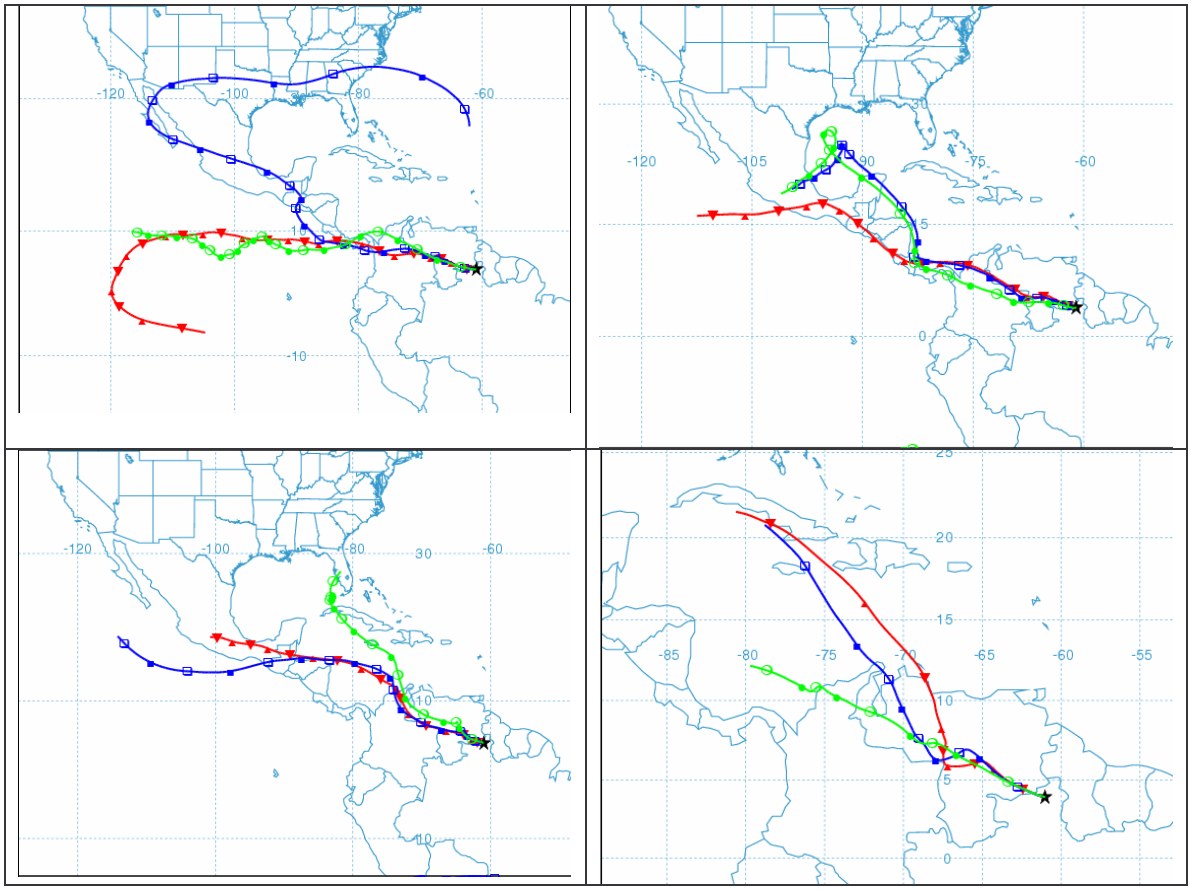


Figure 1. Trajectory analysis for Roraima 3.9 N and 61.00 W (clockwise from top left: July 30, August 2, 3, 7).

Analysis of data from Cali, Columbia

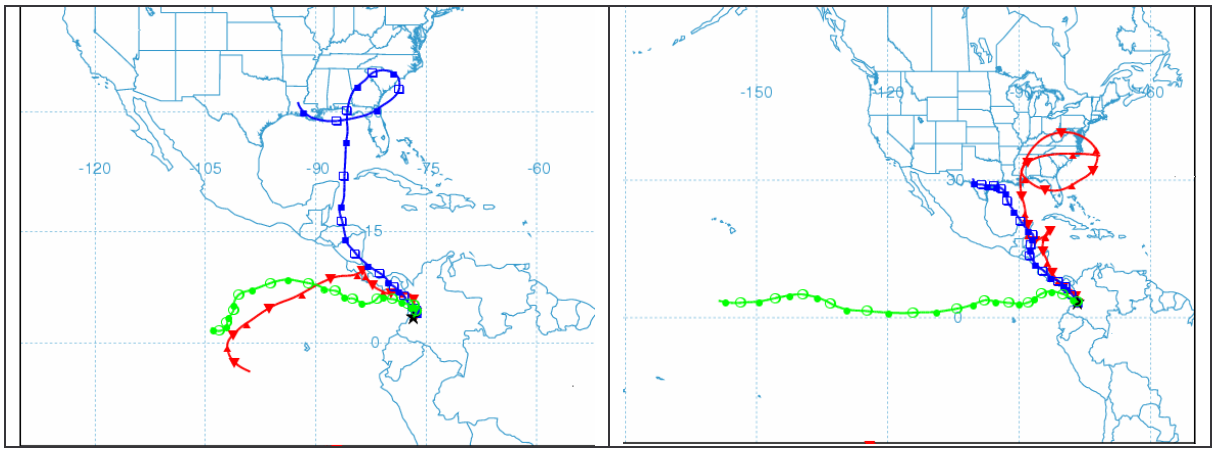
There have been recent unconfirmed reports of soybean rust outbreaks in Cali, Columbia. It is unknown how long soybean rust has been at this site. Trajectory runs were made for 68 days in June, July and August (data continuity problems rendered the July 31 runs useless; the total is thus one less than for Roraima). Each run lasted for a 12-day period and included launch altitudes of 100m (red triangles), 200m (blue squares), and 500m (green circles).

Table 2. Trajectory analysis beginning in Cali, Columbia, 3.5 N and 76.70 W for 68 days in June, July and August 2004

Region impacted by air parcels	Days	Percent
Central America	56	82
Caribbean	7	10
Mexico	20	29
United States	5	7

The percentage of the runs from Cali, Columbia impacting Central America and Mexico is similar to that of the runs originating in Roraima (Table 2). Differences arise in the percentage of runs from the Columbian source region impacting the Caribbean and the United States. They number 10 and 7, respectively, for Cali, Columbia which is roughly half that of the 10 and 7 for Roraima.

The trajectories for June, July and early August 2004 from the Columbian source region more frequently track westward into the Pacific Ocean than runs from Roraima. The general westward movement of the Columbian trajectories and their lesser likelihood of Caribbean and U.S. impact may be because air parcels originating from mountain valleys in the northern South America Andes are too far west to be affected by large scale convergence into tropical weather systems that dominate the Caribbean basin at this time of year. This suspicion should be viewed with caution. Further analysis, using mulitple years of data and for a longer time period each year, would be necessary before this idea could be stated with greater conviction.



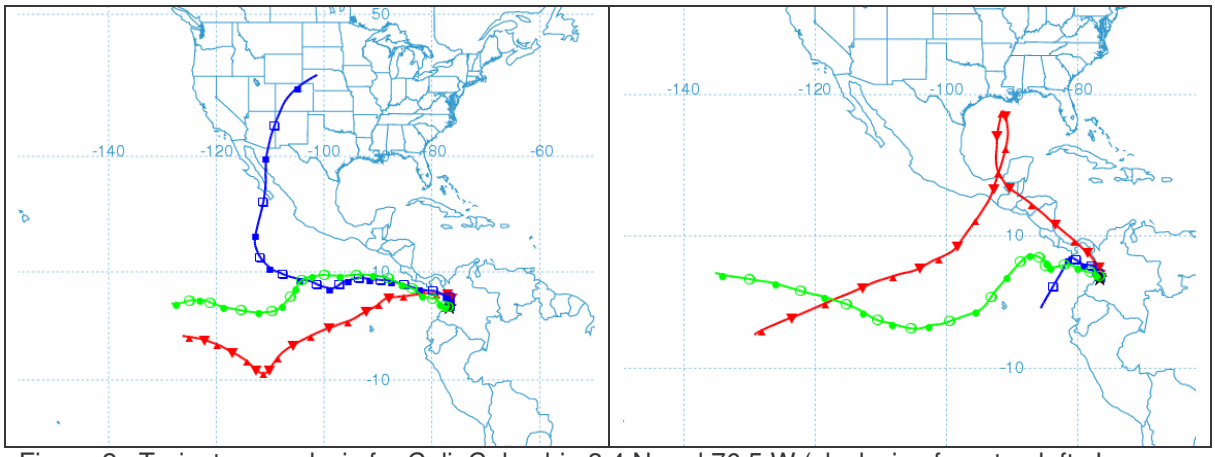


Figure 2. Trajectory analysis for Cali, Columbia 3.4 N and 76.5 W (clockwise from top left: June 5, June 7, June 27 and July 4).

Literature Cited

Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://www.arl.noaa.gov/ready/hysplit4.html). NOAA Air Resources Laboratory, Silver Spring, MD.

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