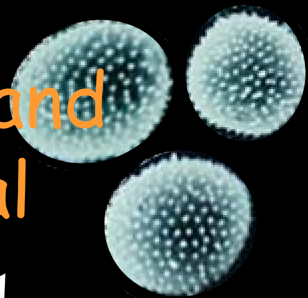
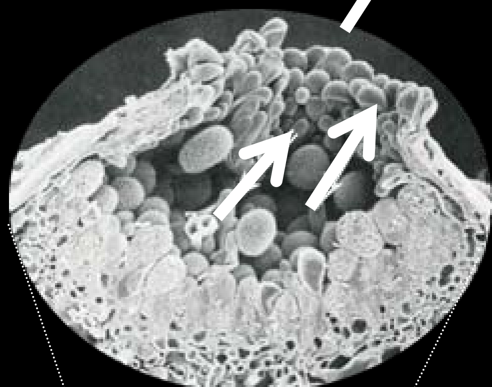
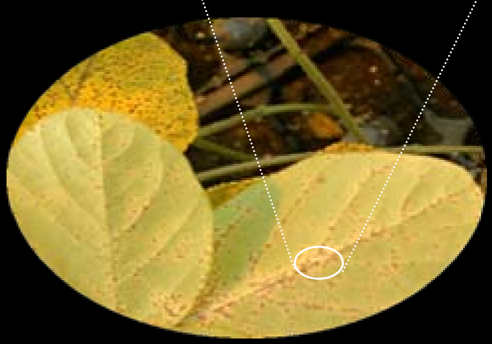
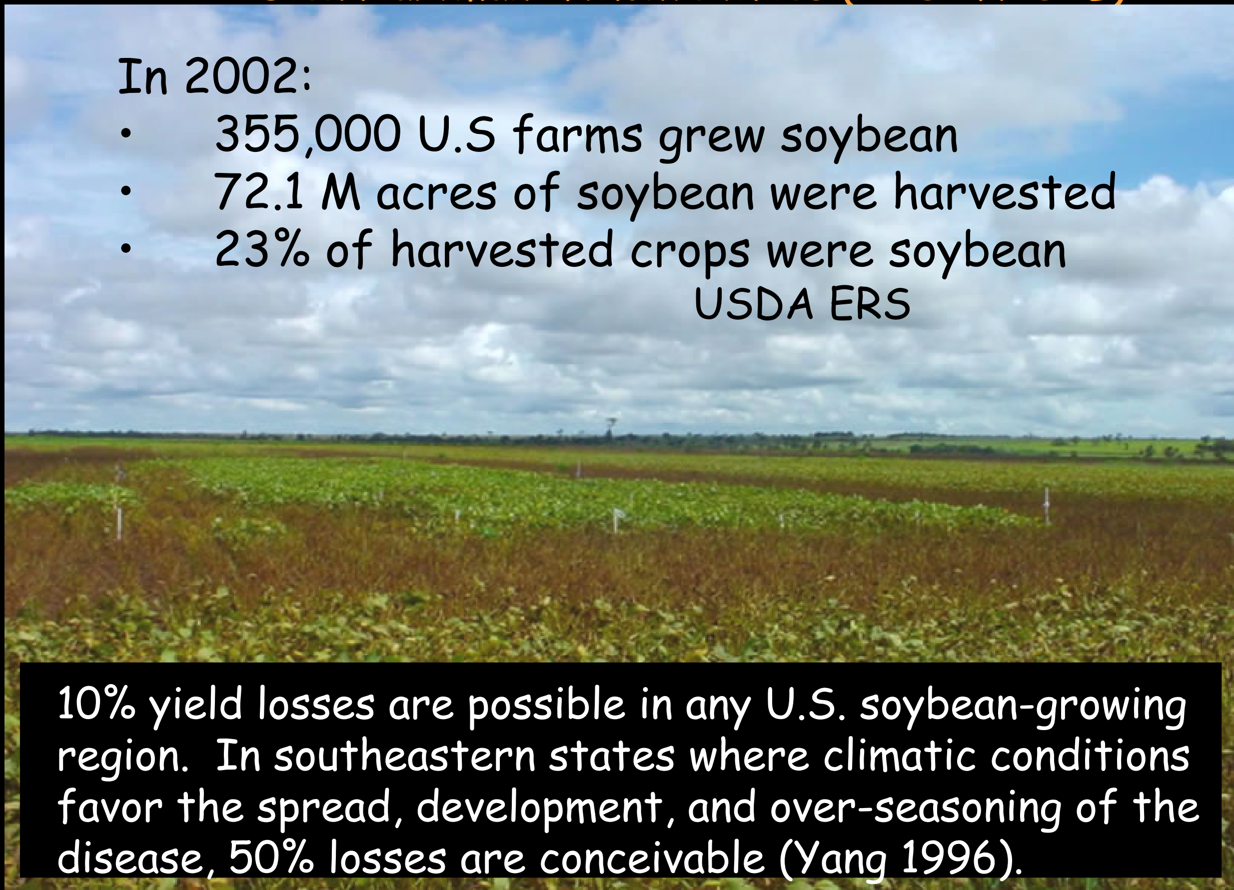
Survey planning for soybean rust based on aerobiological and climatological factors



Roger Magarey (APHIS) & Scott Isard (UI)
Joe Russo (ZedX) & Stuart Gage (MSU)
Glen Hartman & Monte Miles (ARS & NSRL)







In 2002:

- 355,000 U.S farms grew soybean
- 72.1 M acres of soybean were harvested
- 23% of harvested crops were soybean

USDA ERS

10% yield losses are possible in any U.S. soybean-growing region. In southeastern states where climatic conditions favor the spread, development, and over-seasoning of the disease, 50% losses are conceivable (Yang 1996).

In this slide presentation we will provide maps that may be helpful in determining where and when to scout for soybean rust.

This analysis was conducted in March, 2004. An updated analysis is anticipated in July, 2004 based upon model improvements and new confirmations of disease reports in South America

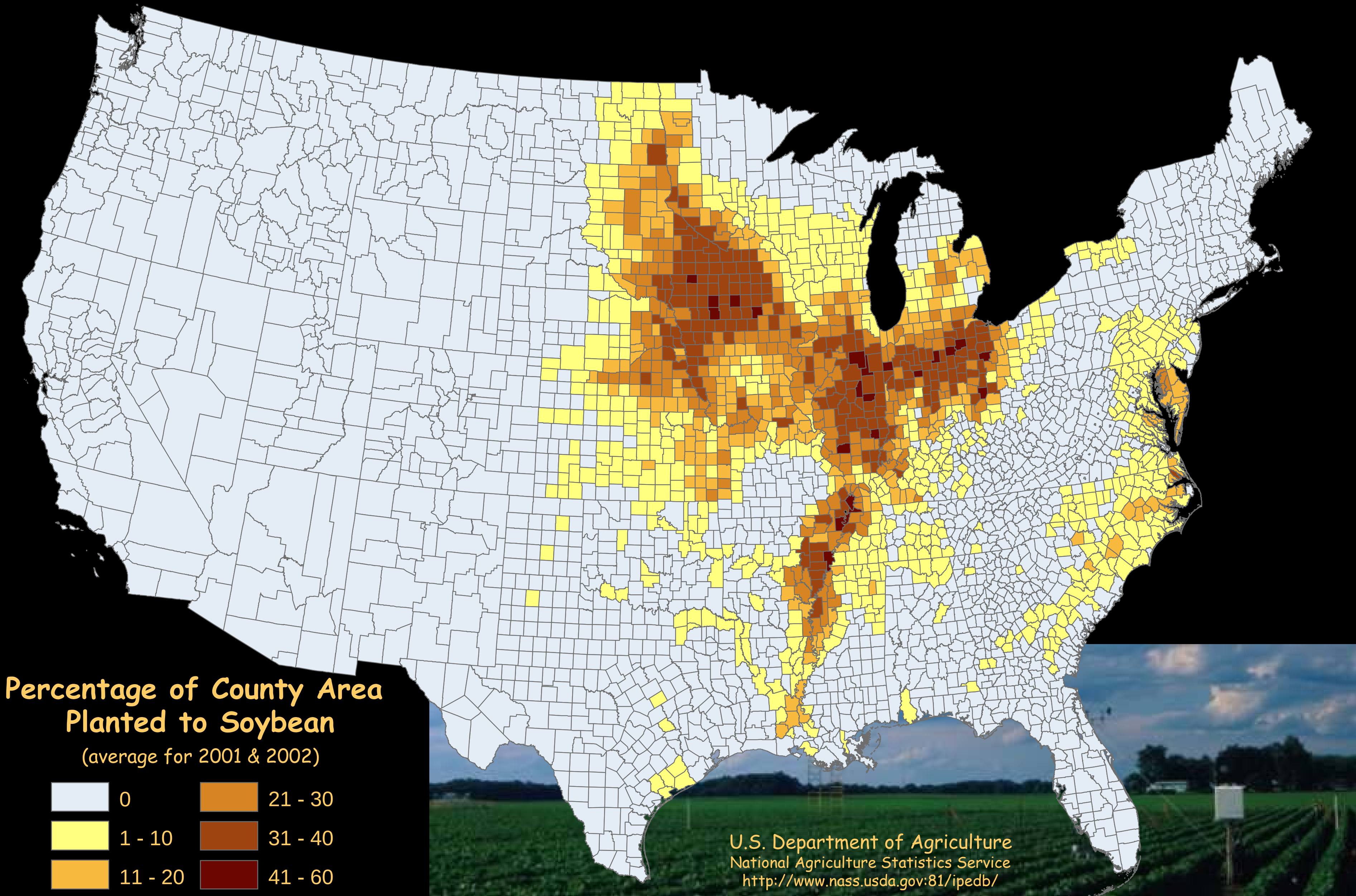
The survey maps assume that rust will enter via aerial pathways, although other human-assisted pathways are possible.

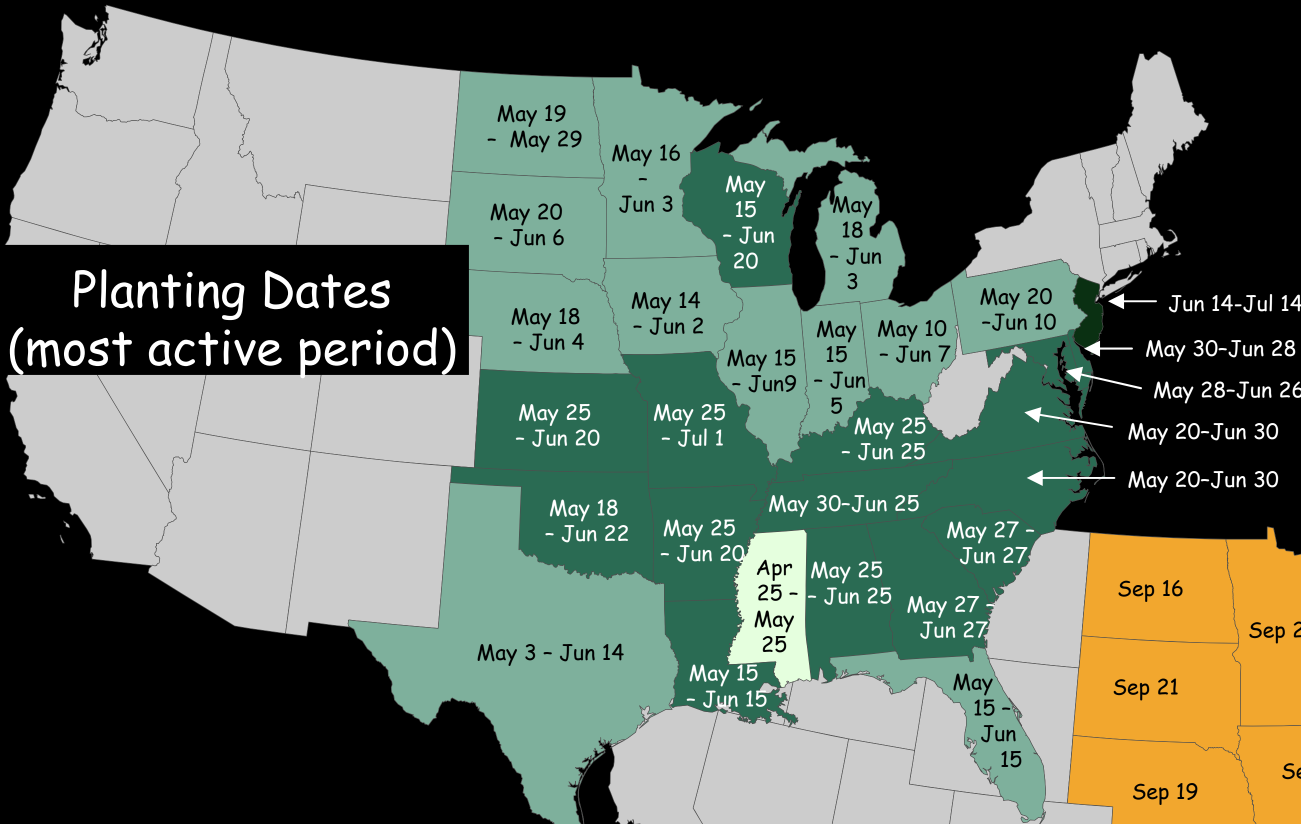
First, we will show you maps of where and when soybeans are grown.

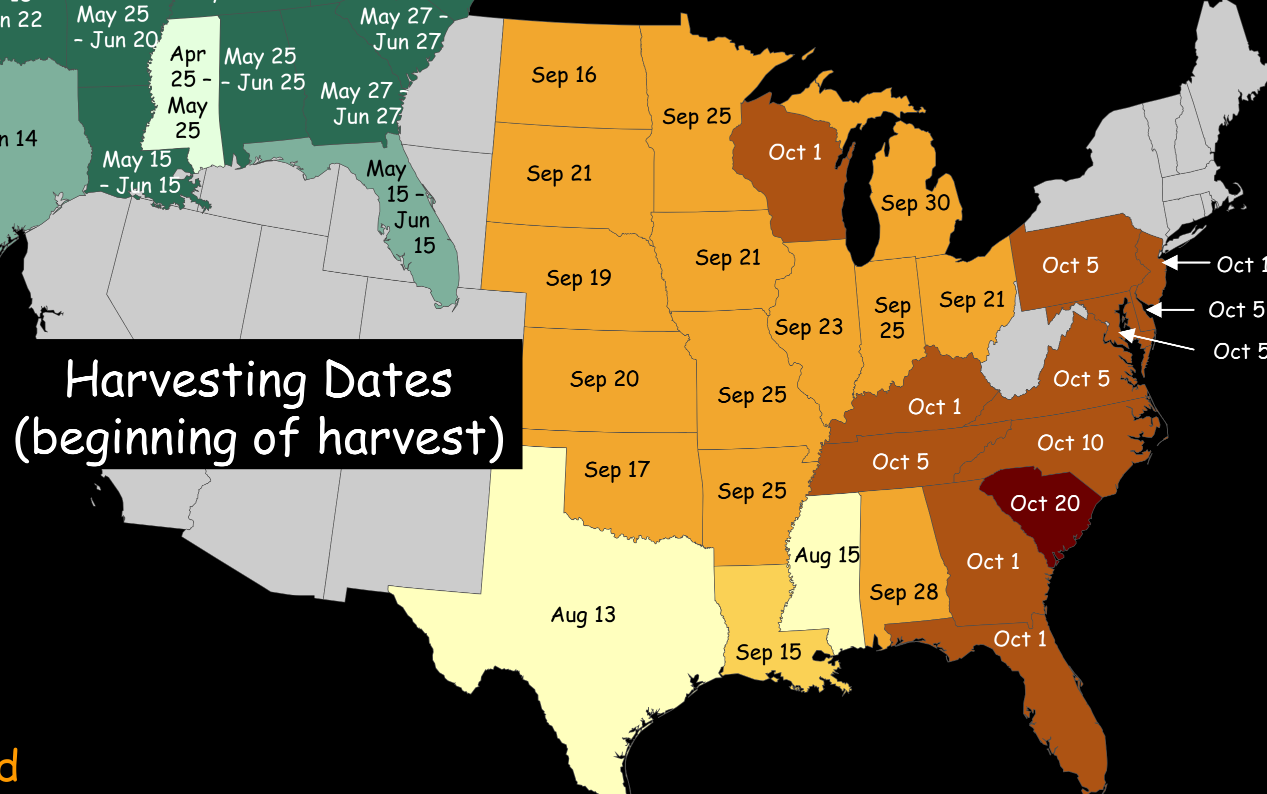
This includes where kudzu (an alternative host) is grown.

There are many other alternative hosts for the disease that may be important for survey programs but these are not included in the analysis.

U.S. Soybean Production







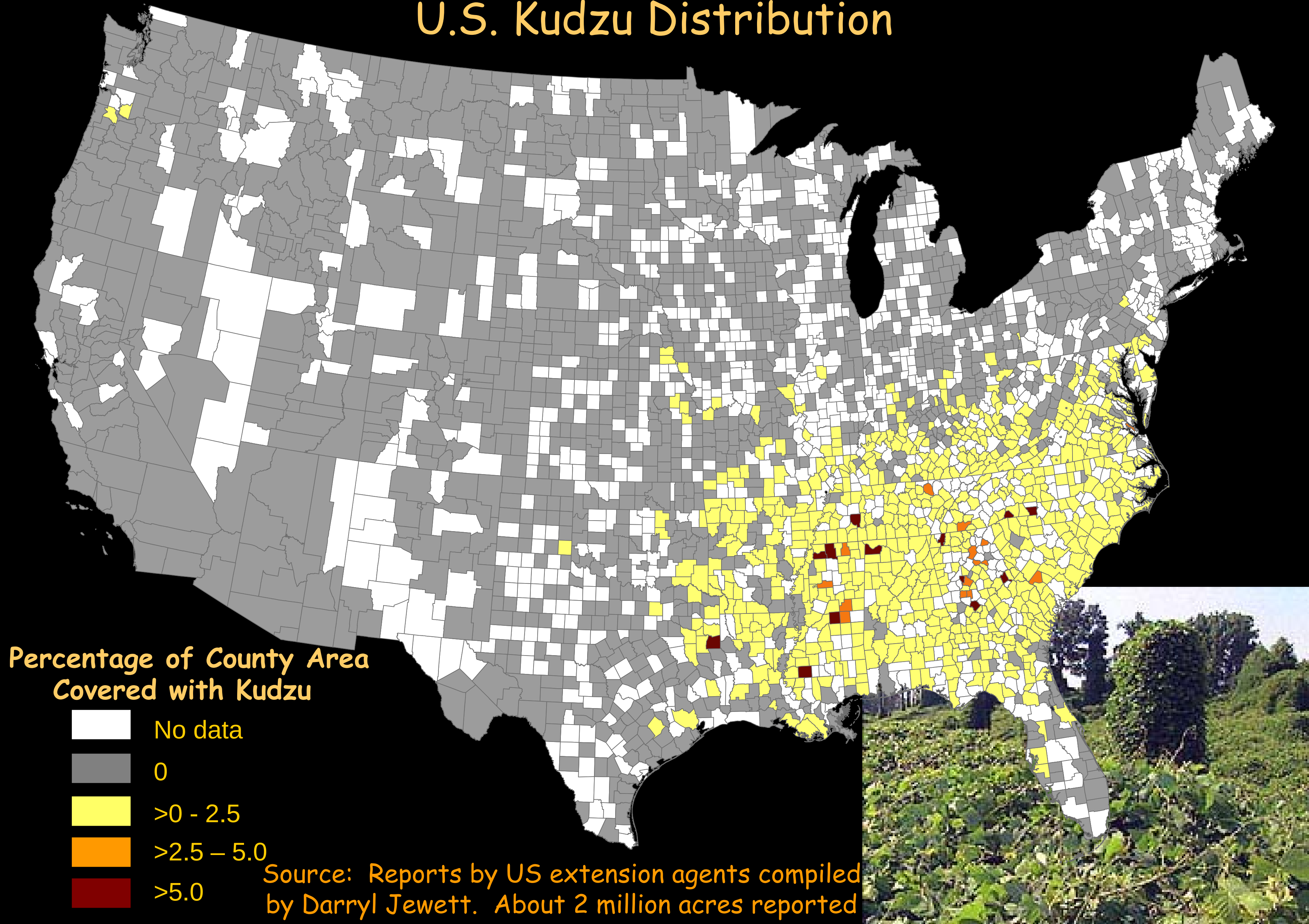
Soybean: Usual Planting and Harvesting Dates

Agricultural Statistics Board

NASS USDA


CORN
KUDZU
SOYBEAN

U.S. Kudzu Distribution



Source: Reports by US extension agents compiled by Darryl Jewett. About 2 million acres reported

In the next section, we will show how the risk of soybean rust changes over the growing season.

The top map shows the potential for soybean rust epidemics based upon climate. For most growing regions this is high all season.

The bottom map is designed to indicate where air parcels originating in confirmed soybean rust regions south of the equator in South America are likely to arrive in the US. The Appalachian (mid-Atlantic) and south-eastern regions are most frequently crossed by these parcels, most other regions are not at high risk.

The maps require careful interpretation.

The climate map (top map) shows the frequency of seasons favorable for disease spread. The maps show the potential for the development of an epidemic that is initiated in that month. Consequently the risk declines during the growing season.

The map is based upon ten years of daily climatic leaf wetness and air temperature data.

The maps require careful interpretation.

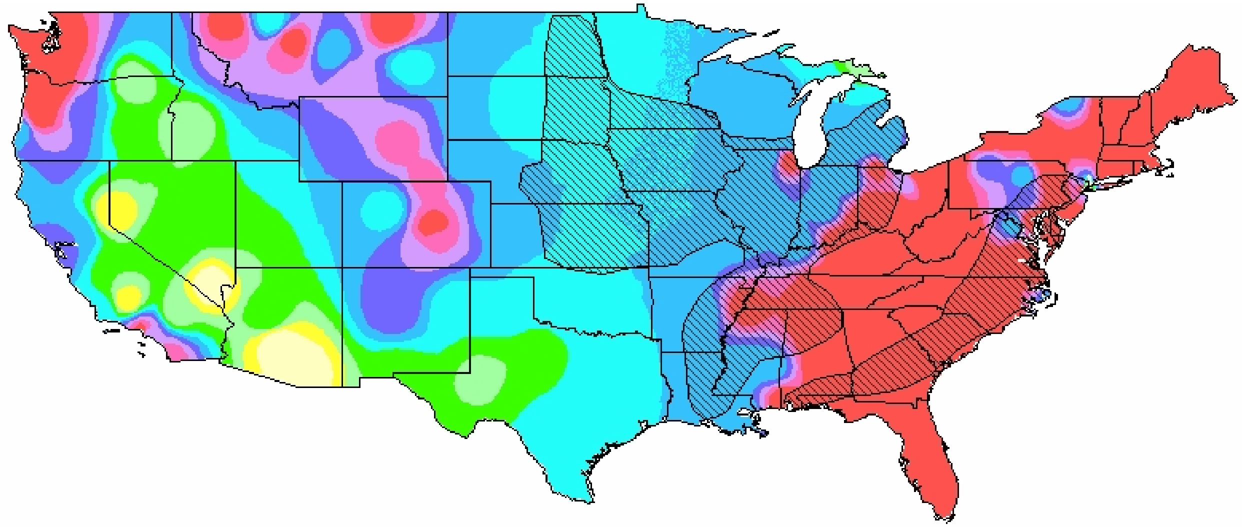
The atmospheric transport map (bottom map) shows the frequency of air parcel hits over the United States. The maps are based upon ten years of data. The maps do not consider the survival of spores. Consequently, the maps only show the relative pathways spores might travel.

Note carefully…

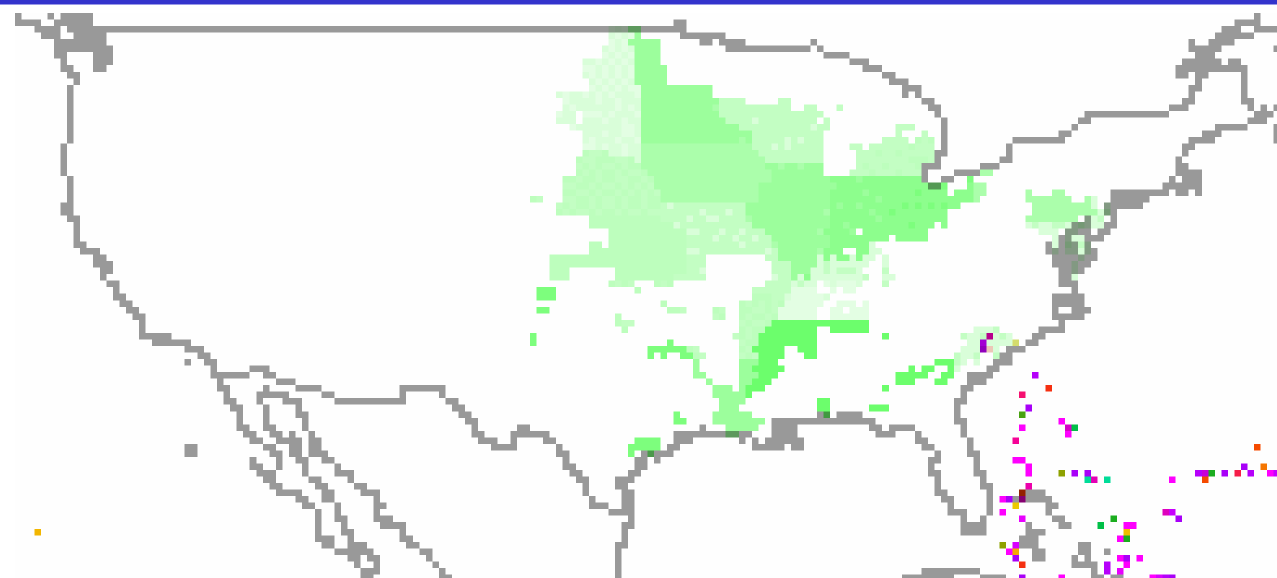
Other model simulations (not shown in this power point) indicate that spores will **not** survive transport from the current confirmed infestations south of the equator in South America to the US in a single jump. Spores are lost as a result of exposure to UV and wet deposition. The pathogen will have to migrate via a series of jumps either through the Caribbean or Central America. However, the air parcel maps show the pathways of spore movement and can be updated when new source regions appear.

April

Climatic risk
Red indicates every year favorable, yellow unfavorable
Hatched areas indicate soybean production

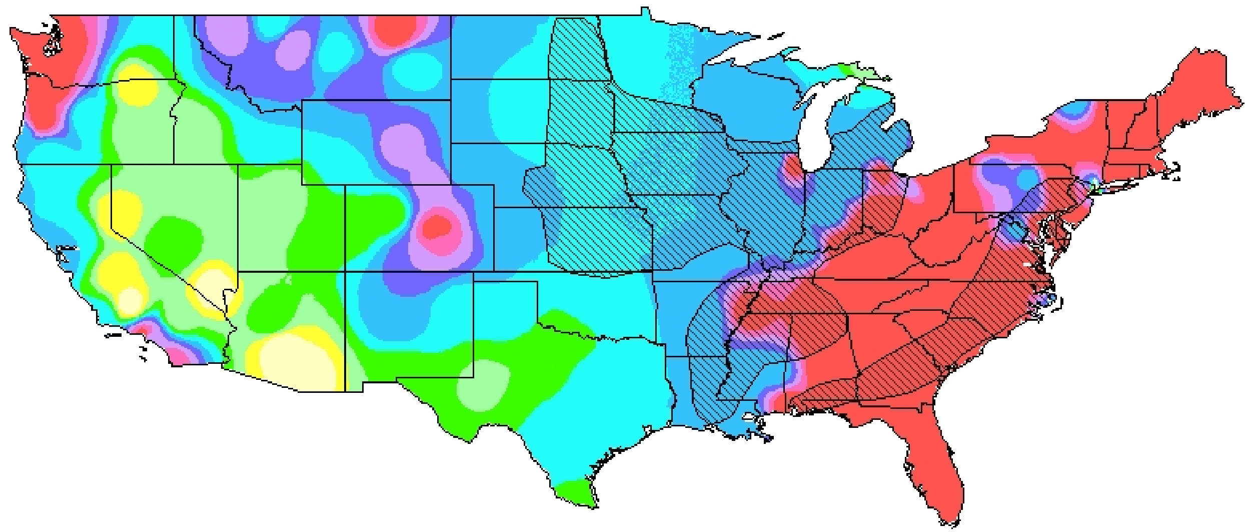


Aerial transport
Frequency of hits (purple spots) by air parcels from South America
Green areas indicate soybean production

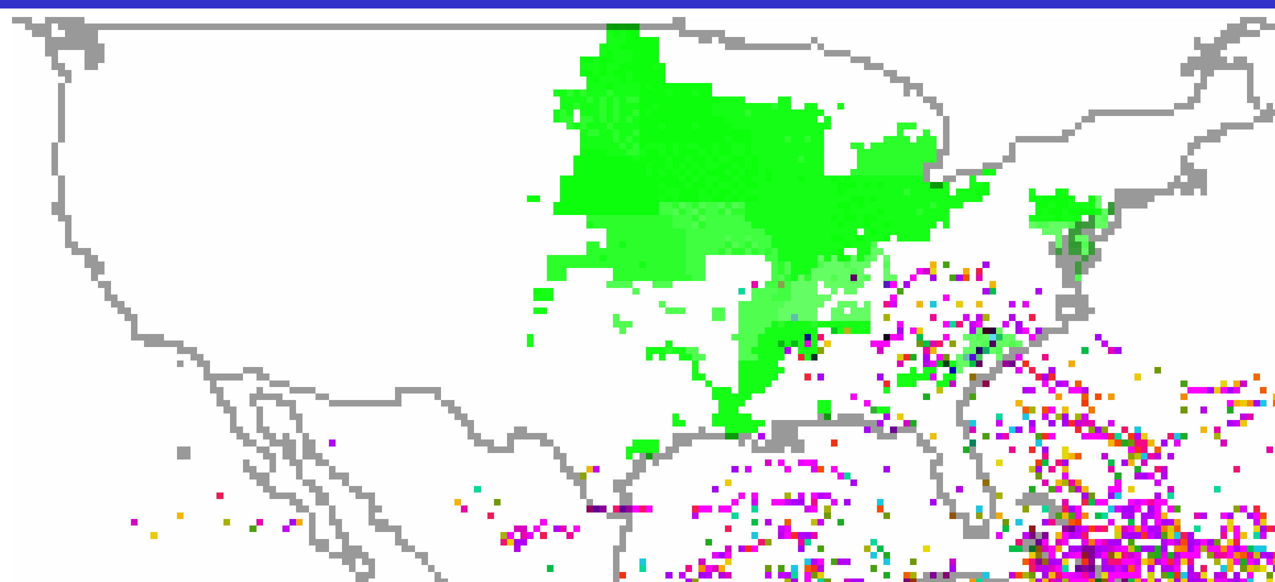


May

Climatic risk
Red indicates every year favorable, yellow unfavorable
Hatched areas indicate soybean production

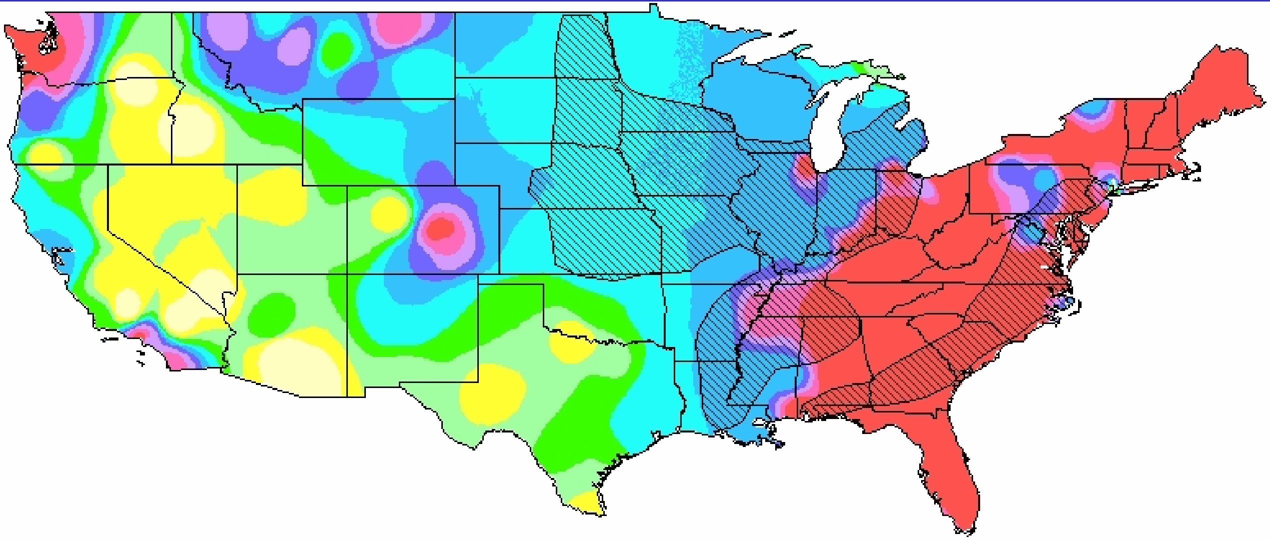


Aerial transport
Frequency of hits (purple spots) by air parcels from South America
Green areas indicate Soybean production



June

Climatic risk
Red indicates every year favorable, yellow unfavorable
Hatched areas indicate soybean production



Aerial transport
Frequency of hits (purple spots) by air parcels from South America
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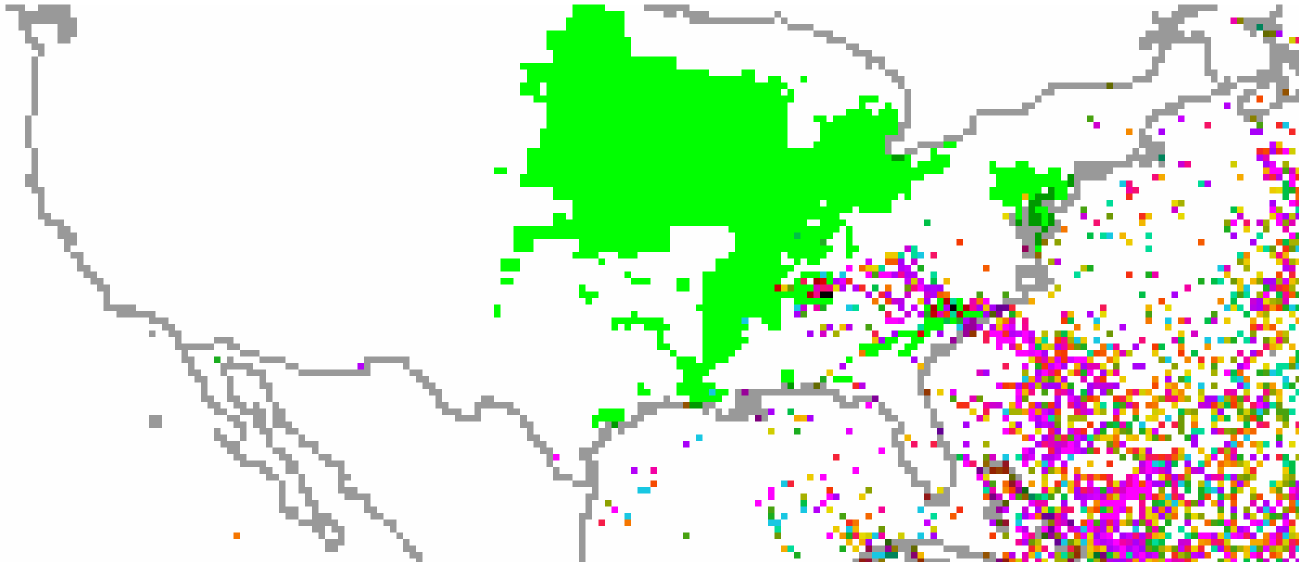
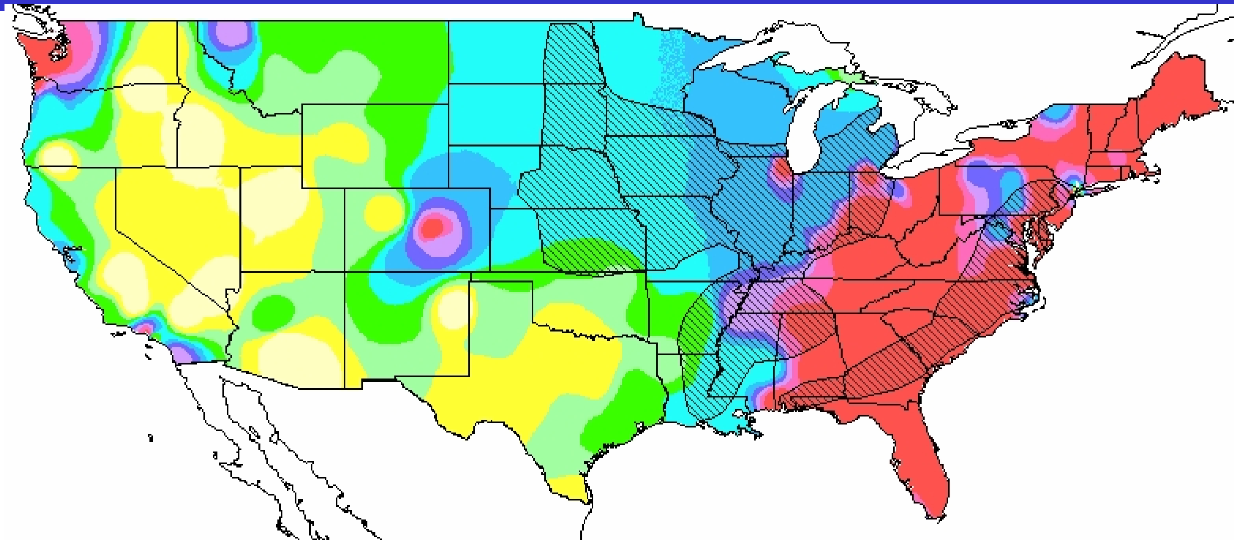
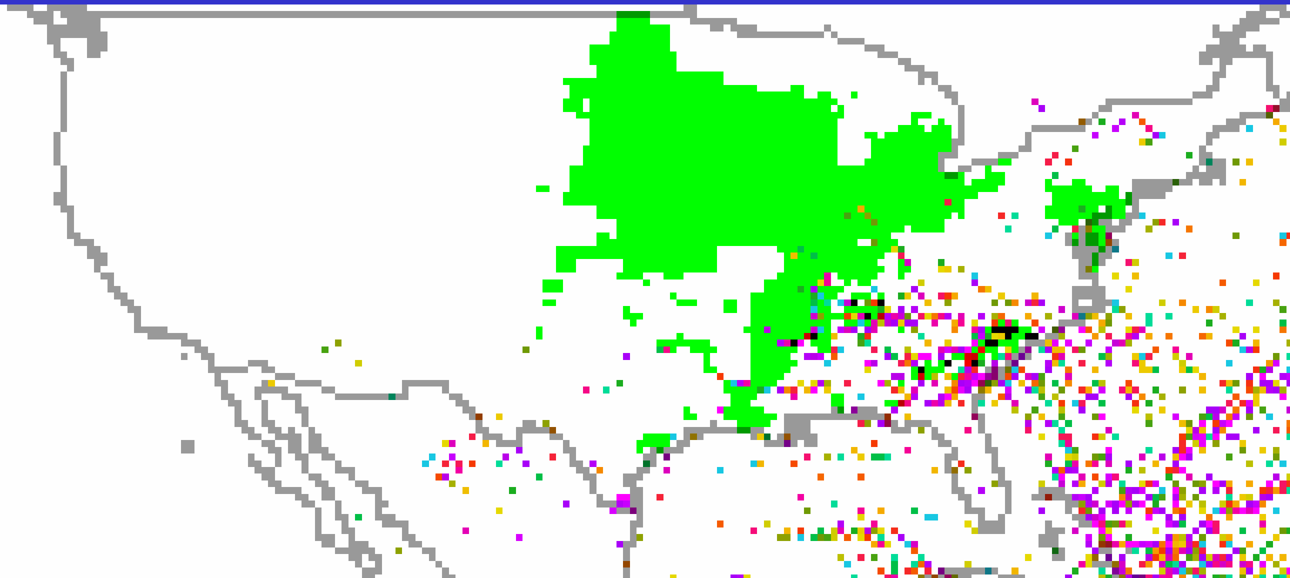


July

Climatic risk
Red indicates every year favorable, yellow unfavorable
Hatched areas indicate soybean production



Aerial transport
Frequency of hits (purple spots) by air parcels from South America
Green areas indicate Soybean production

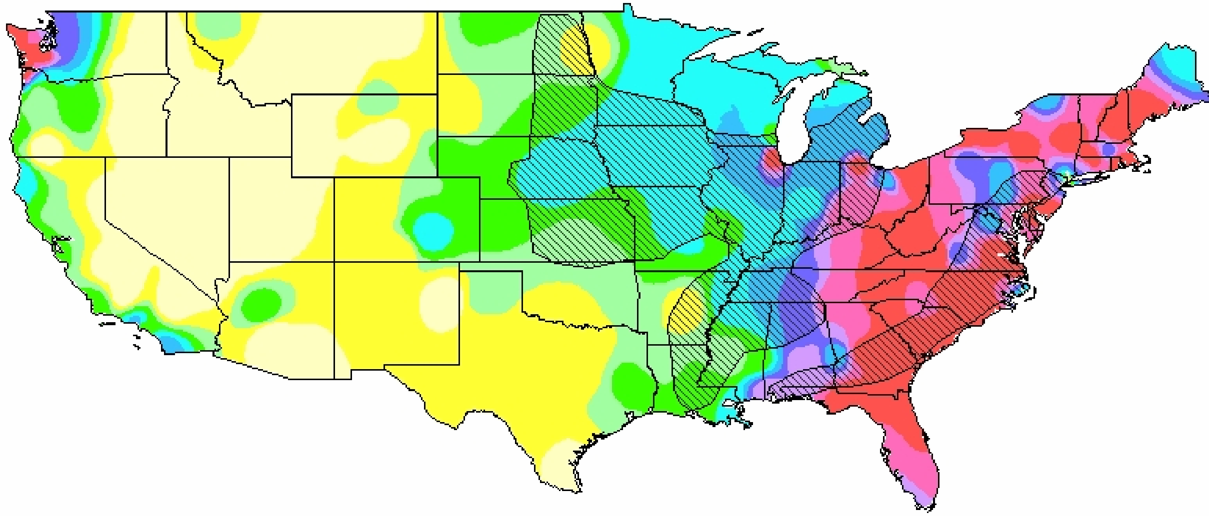


August

Climatic risk

Red indicates every year favorable, yellow unfavorable

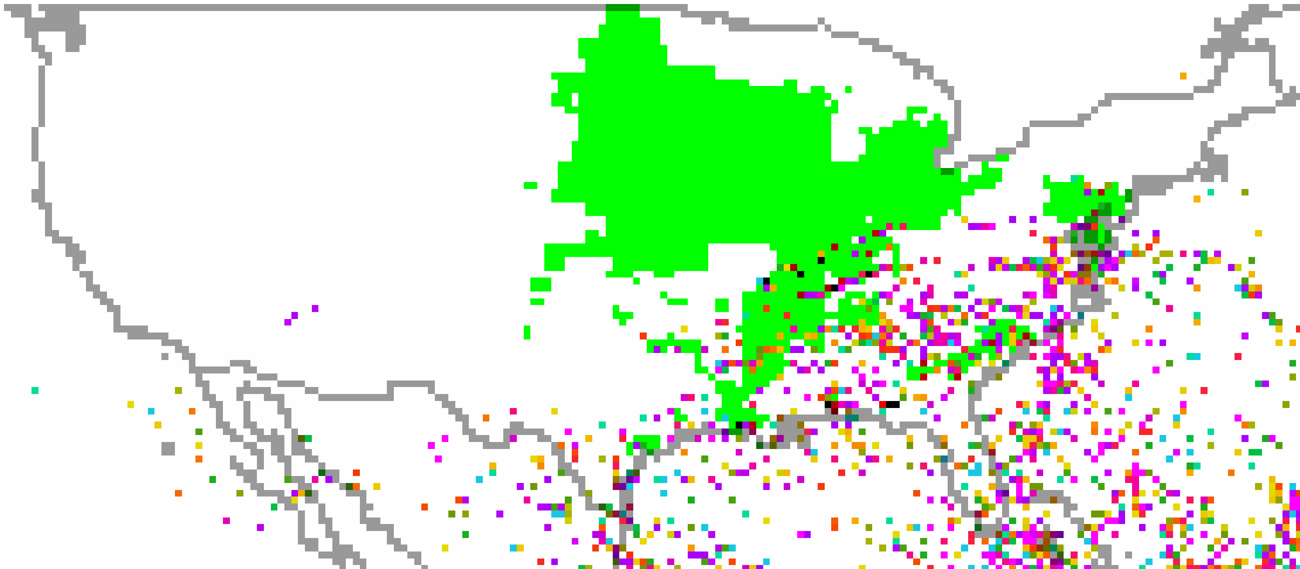
Hatched areas indicate soybean production



Aerial transport

Frequency of hits (purple spots) by air parcels from South America

Green areas indicate Soybean production

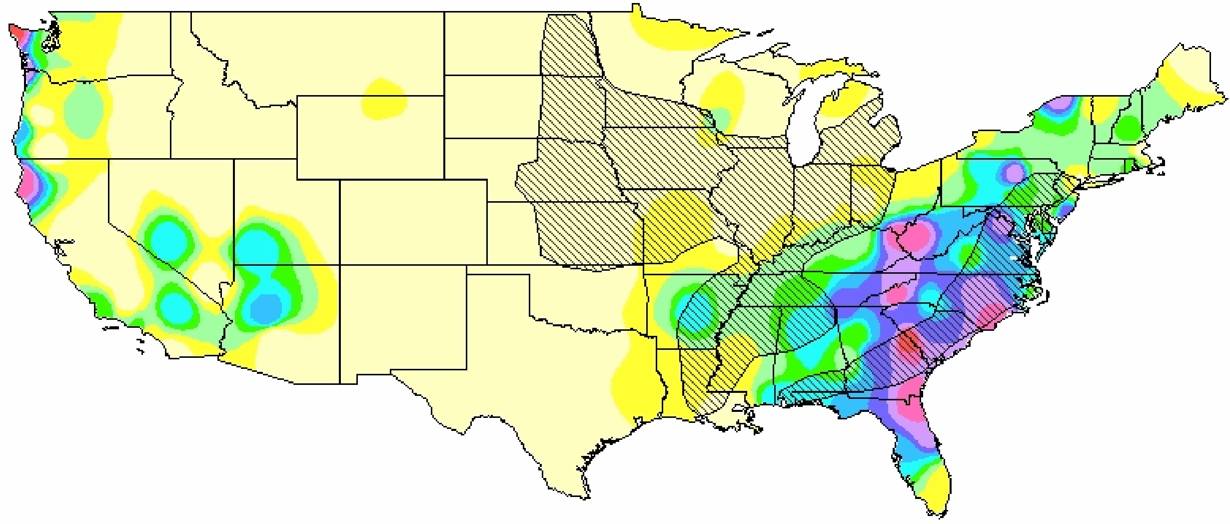


September

Climatic risk

Red indicates every year favorable, yellow unfavorable

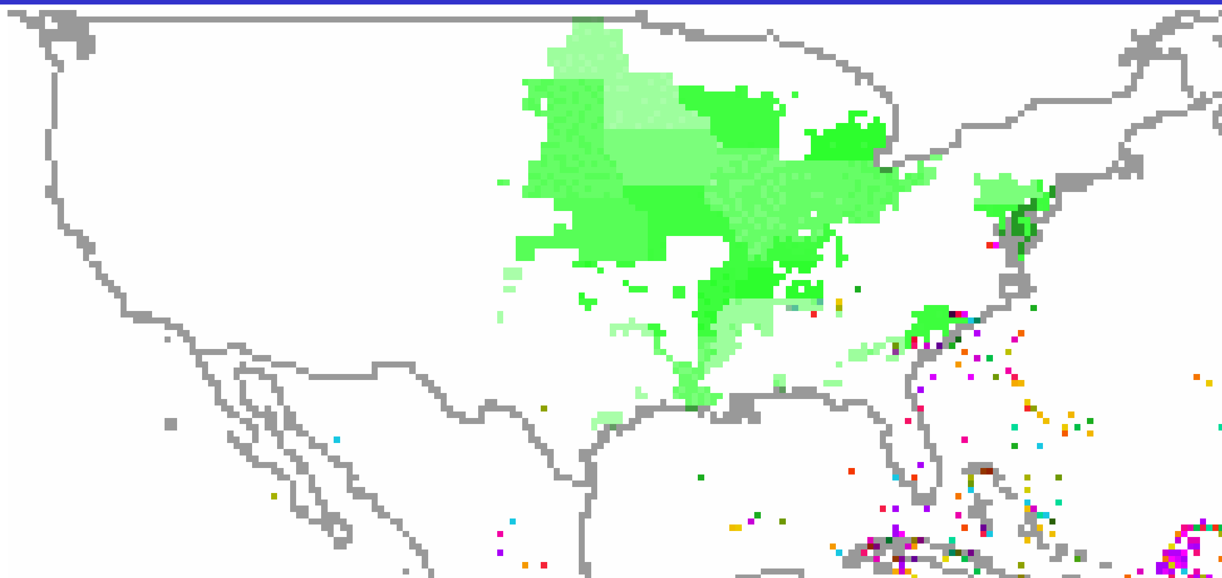
Hatched areas indicate soybean production



Aerial transport

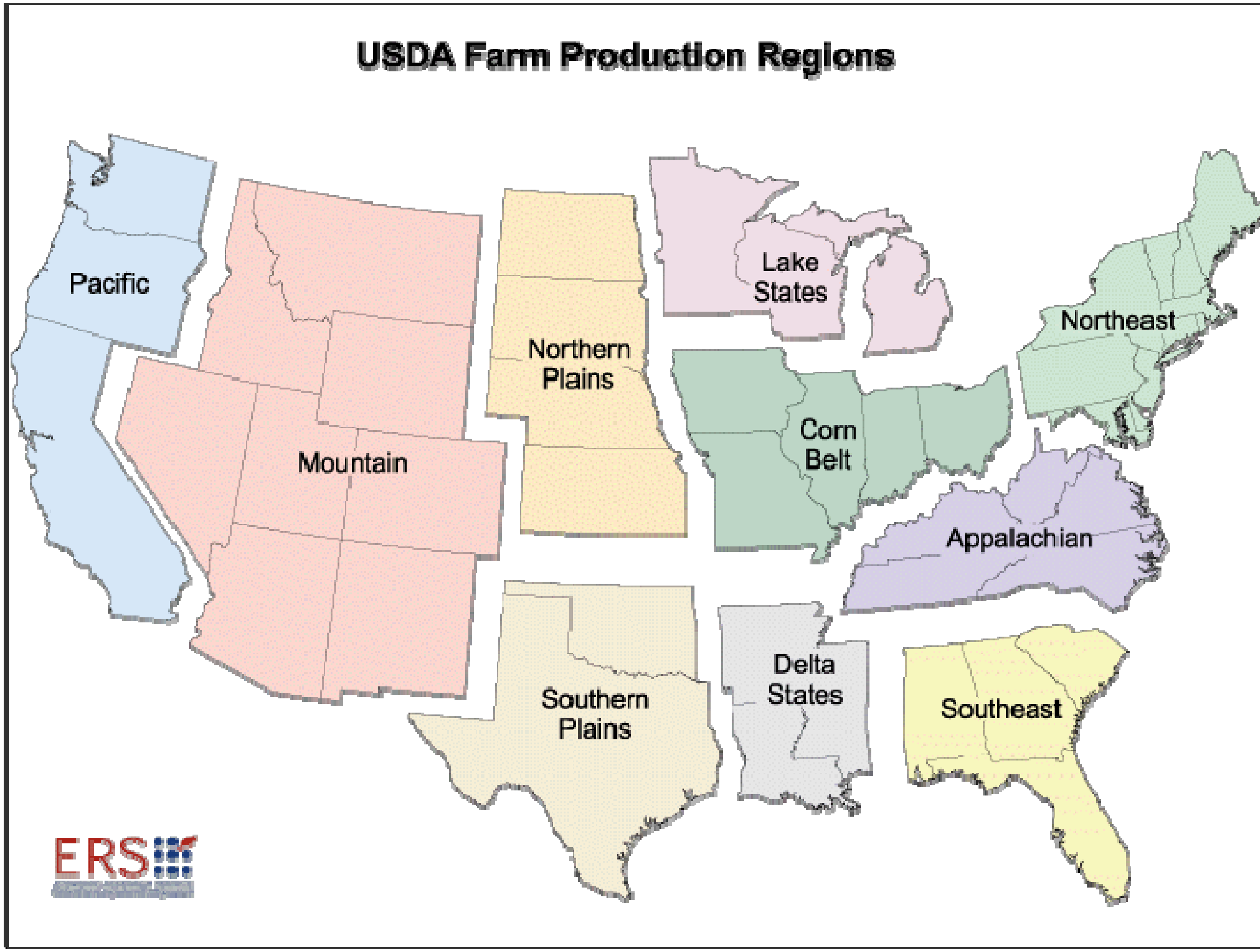
Frequency of hits (purple spots) by air parcels from South America

Green areas indicate Soybean production



Finally, we will show you a graph summarizing this information. The graph shows the risk potential in six two-month periods and in the ten USDA agricultural regions.

Here are the USDA regions.

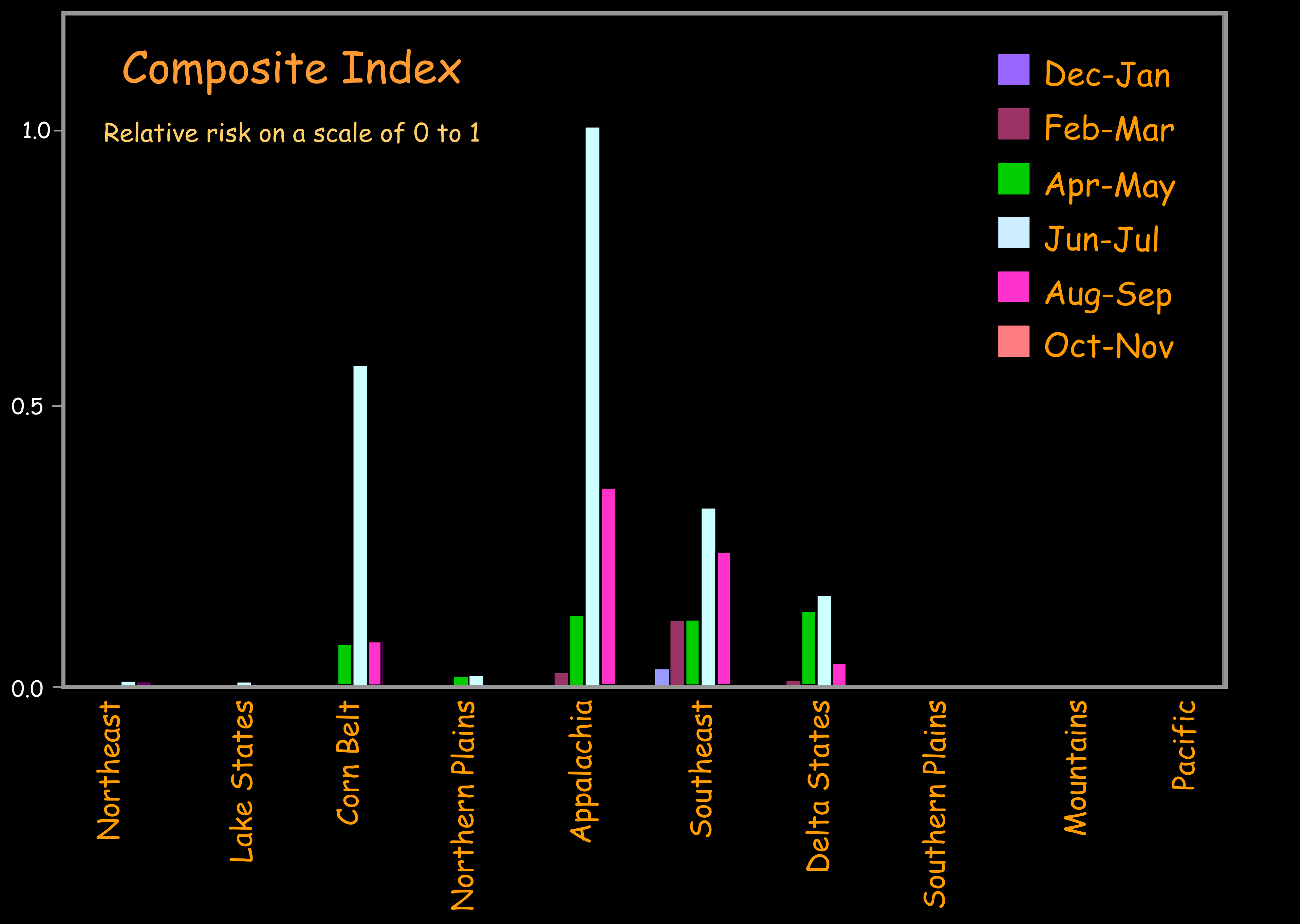


Note the Appalachian region includes soybean production areas in NC and VA .

The graph shows the risk potential according to four factors.

1. Spore production in South America
2. Transport (atmosphere)
3. Host distribution in the US
4. Epidemic development

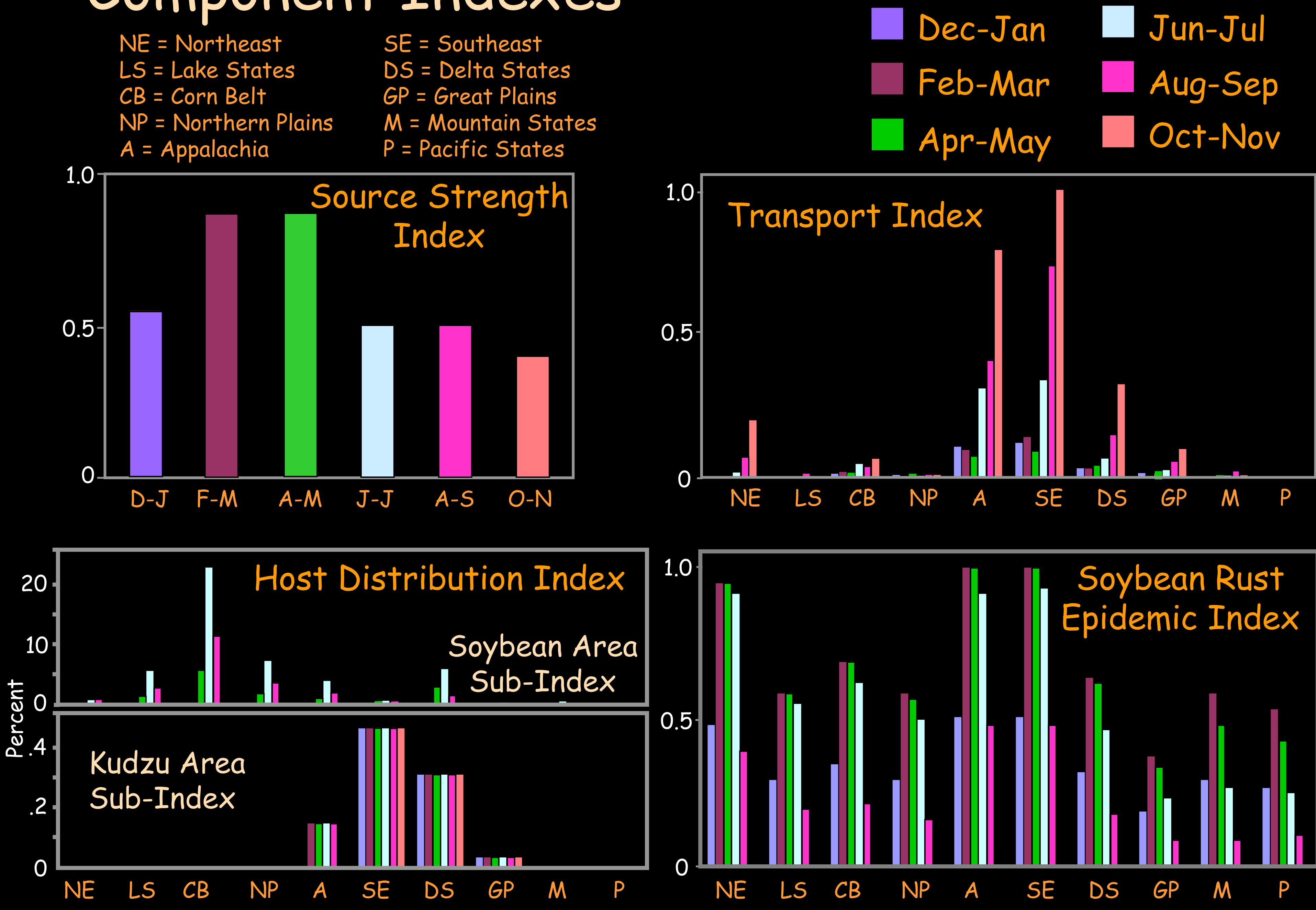
First, we will show you a graph summarizing the overall risk and then four graphs demonstrating the contribution of each factor.



Composite Index
Relative risk on a scale of 0 to 1
1.0
0.5
0.0
Dec-Jan
Feb-Mar
Apr-May
Jun-Jul
Aug-Sep
Oct-Nov
Northeast
Lake States
Corn Belt
Northern Plains
Appalachia
Southeast
Delta States
Southern Plains
Mountains
Pacific

Component Indexes

NE = Northeast
LS = Lake States
CB = Corn Belt
NP = Northern Plains
A = Appalachia
SE = Southeast
DS = Delta States
GP = Great Plains
M = Mountain States
P = Pacific States



In conclusion, these maps show you where and when survey programs for soybean rust might be conducted. It is important to note that this information only provides general trends of where and when to sample and not specific locations or times. Other model simulations show that the pathogen will more likely spread gradually from equatorial Brazil to our country infesting soybean regions in route rather than make the aerial journey directly to our country. The maps will be updated following new confirmations of soybean rust in South and Central America.