Large Peaks Of *Aspergillus Flavus* Propagules Observed At Cotton Fields During Corn Harvest

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APS

plant health 2021 online

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Daniel W McDonald

- **MS Electrical Engineering**
- **Co-Founder & President, Phenotype Screening Corporation**
- **Interests include developing scientific instrumentation and systems which advance agriculture.**

Summary

- *Aspergillus flavus* spore capture data from a 2019 Cotton Incorporated sponsored project was analyzed.
- Multiple sources of information were combined to demonstrate that corn harvest could have been a significant source of *A. flavus* propagules at cotton sites

Collaborators

- University Collaborators

Kathy Lawrence, PhD
Edward Sikora, PhD
Marina Nunes Rondon, PhD
Bisho Lawaju

Carl Bradley, PhD

Sara Thomas-Sharma, PhD
Nelomie Galagedara

Heather Kelly, PhD
Rachel Guyer,
Elias Zuchelli

- Commercial Team

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assuredbio™

mesur.io™

Sponsored by: Cotton Incorporated

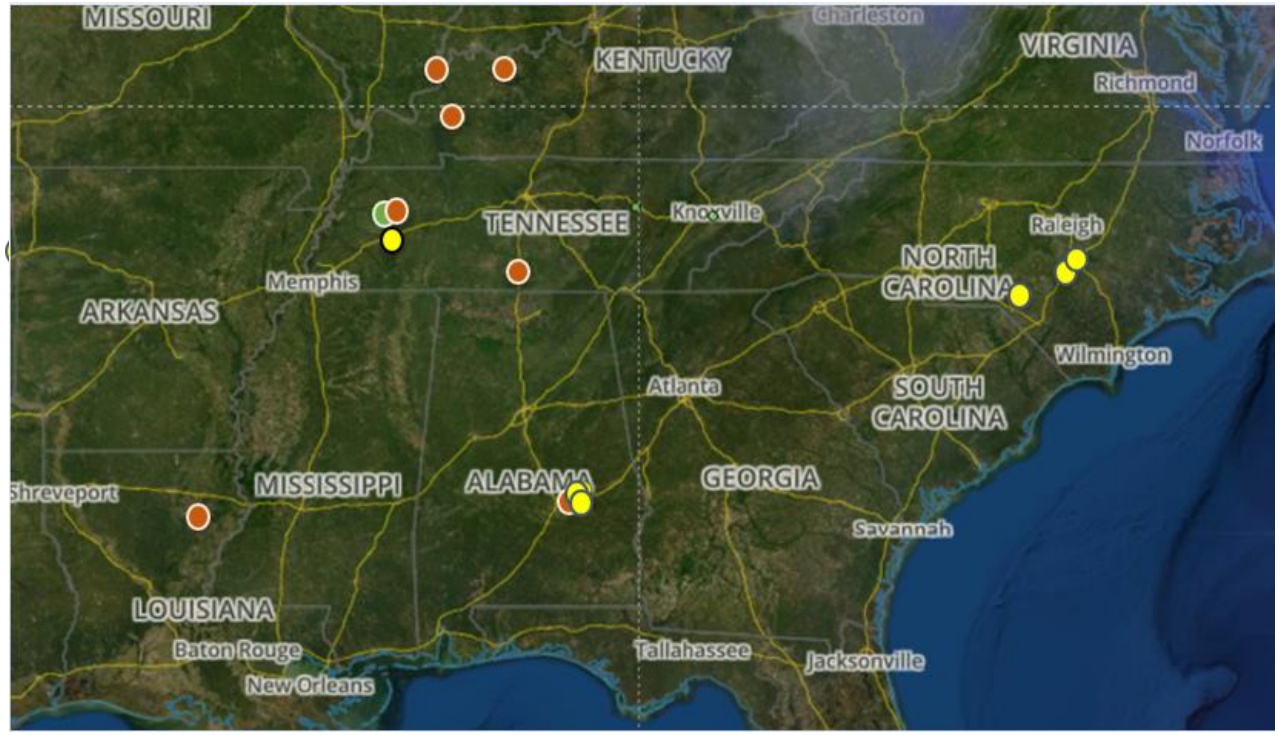
Cotton Incorporated

Kater Hake, PhD

Background

Fourteen row crop sites were monitored biweekly across the southeastern United States for five air-borne pathogens, *Alternaria alternata*, *Corynespora cassiicola, Cercospora sojina, Cercospora zeae-maydis* and *Aspergillus flavus*.

The sites included seven soybean sites, one corn site, and six cotton sites. All but three sites were University research sites. The remaining three sites were commercial cotton fields.



University Collaborators

- University collaborators installed passive air-borne pathogen capture systems near their research plots.
- They exchanged monitoring cassettes on a biweekly basis and submitted them for DNA analysis.
- They provided biweekly disease incidence and severity ratings for their plots.
- They provided consultation on results interpretation.

Commercial Collaborators

- Phenotype Screening Corporation

  On-site logistics, technical support, data analysis, data validation

- Mesur.io

  Data analytics, Earthstream data platform, deep learning disease risk models

- Assured Bio Labs

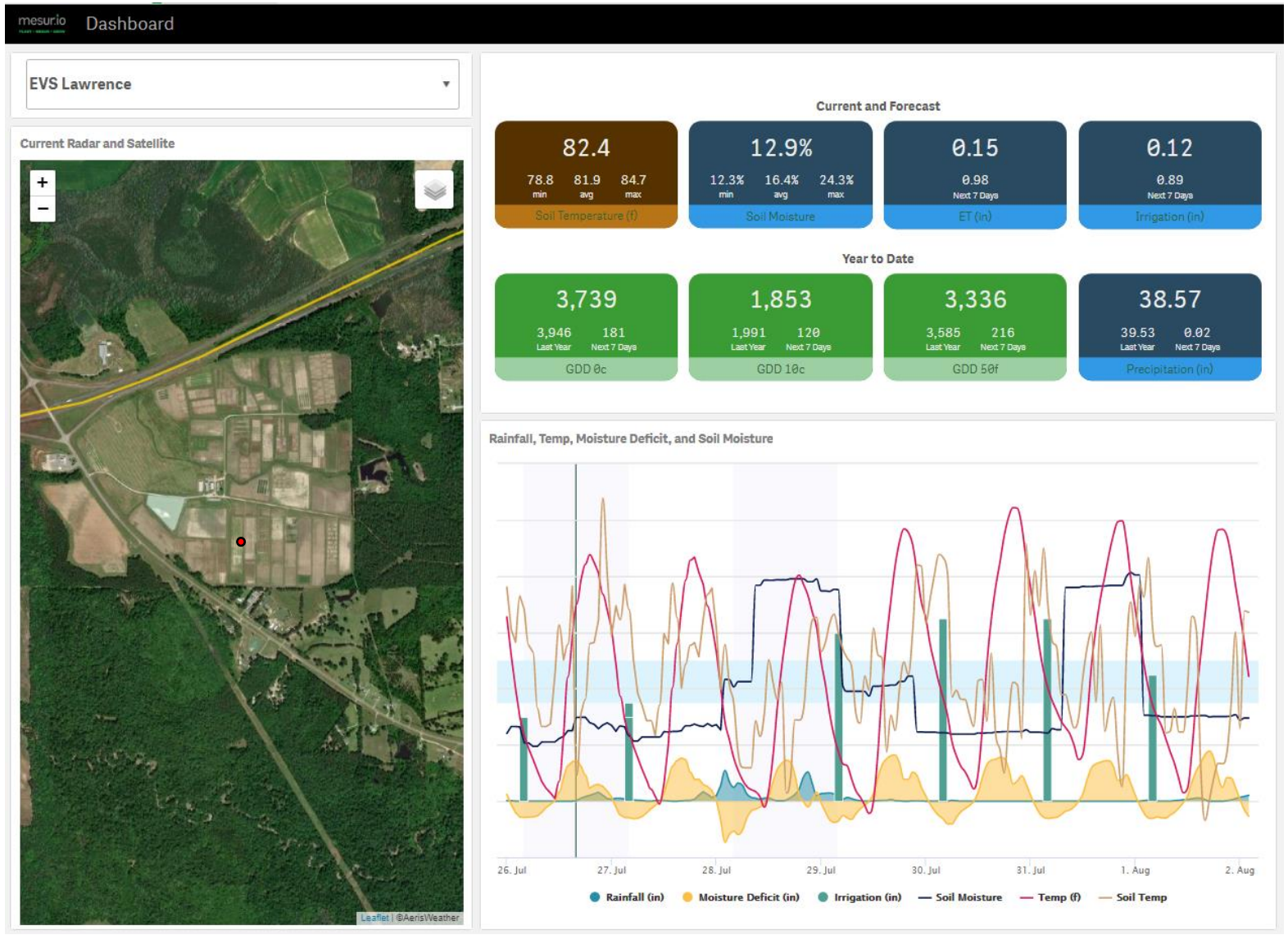
  Capture cassettes technology, probe and primer development, and qPCR services

Spore Capture

High spore capture efficiency cassettes, inserted into passive windsocks were exchanged biweekly and submitted to our partner laboratory, Assured Bio Labs for molecular identification and quantification using qPCR.

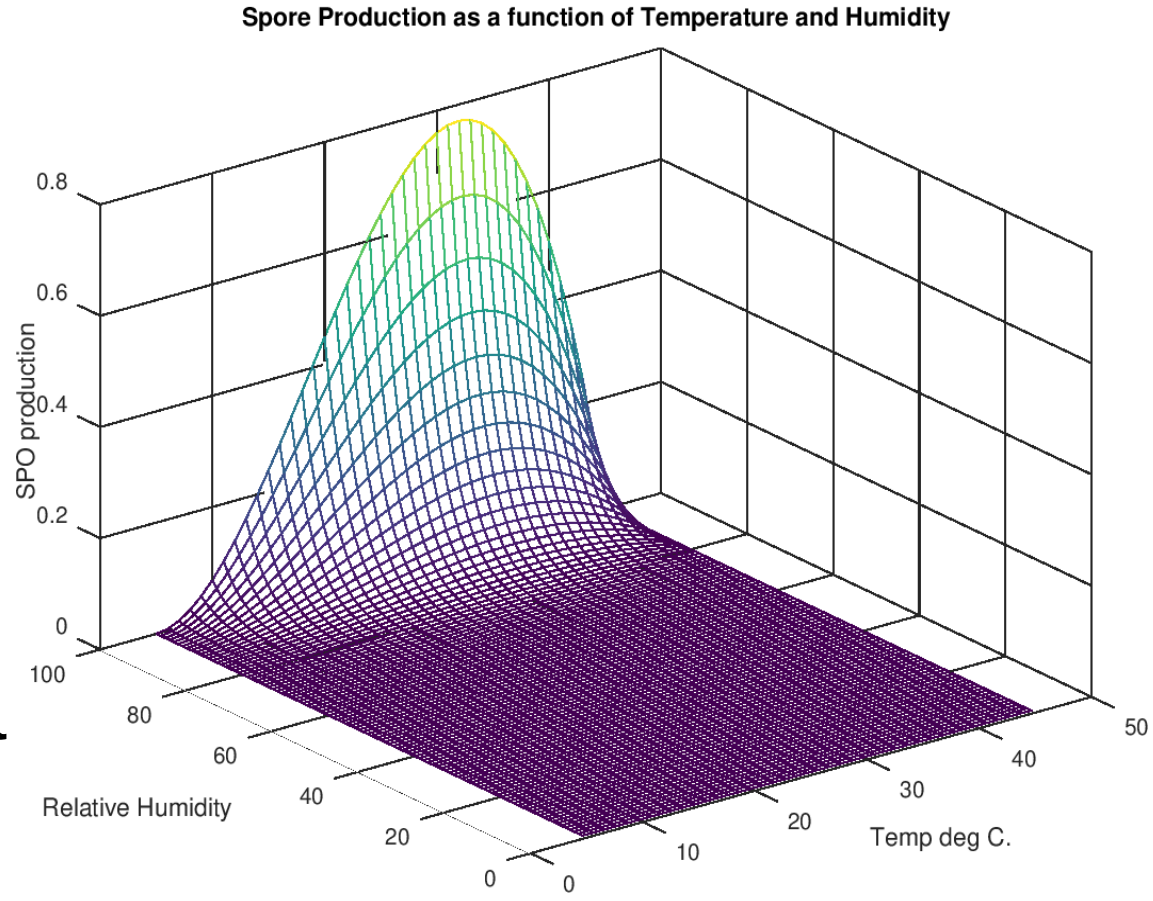
Earthstream Data Dashboard

- Consolidated information about conditions at each site:
- Hourly weather, soil temperature, soil moisture, leaf wetness, degree days, disease risk, spore counts, imagery, georeferenced databases, etc.



Battilani Model

- Environmental suitability model for *A. flavus* sporulation
- Model was implemented by PSC with temperature and relative humidity data provided by mesur.io



P. Battilani, M. Camardo Leggieri, V. Rossi, P. Giorni, AFLA-maize, a mechanistic model for Aspergillus flavus infection and aflatoxin B1 contamination in maize, Computers and Electronics in Agriculture, Volume 94, 2013.

Analysis of Site data

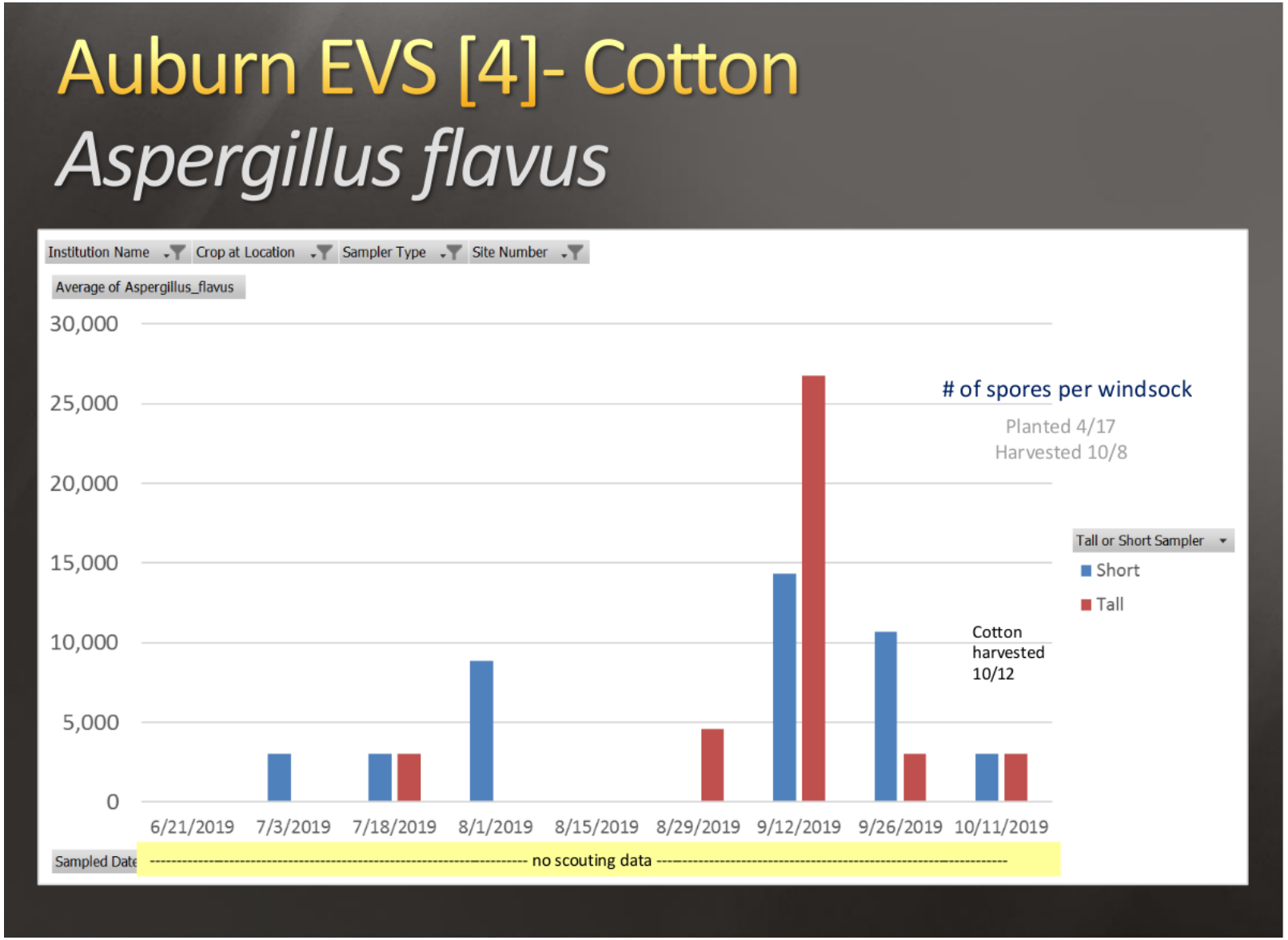
- Nine of eleven sites analyzed for *A. flavus*
- In eight of those nine sites, *A. flavus* spore counts were very high when environmental suitability was very low.
- At other site, no *A. flavus* spores were captured when environmental suitability was low
- An example cotton site is shown below. Results from all sites are shown in Appendix document

Example Site

- EVS Lawrence Site
- 2019 spore data
- Cotton Field managed by Auburn University in Alabama
- Red dot shows field location

A. flavus spore counts by date

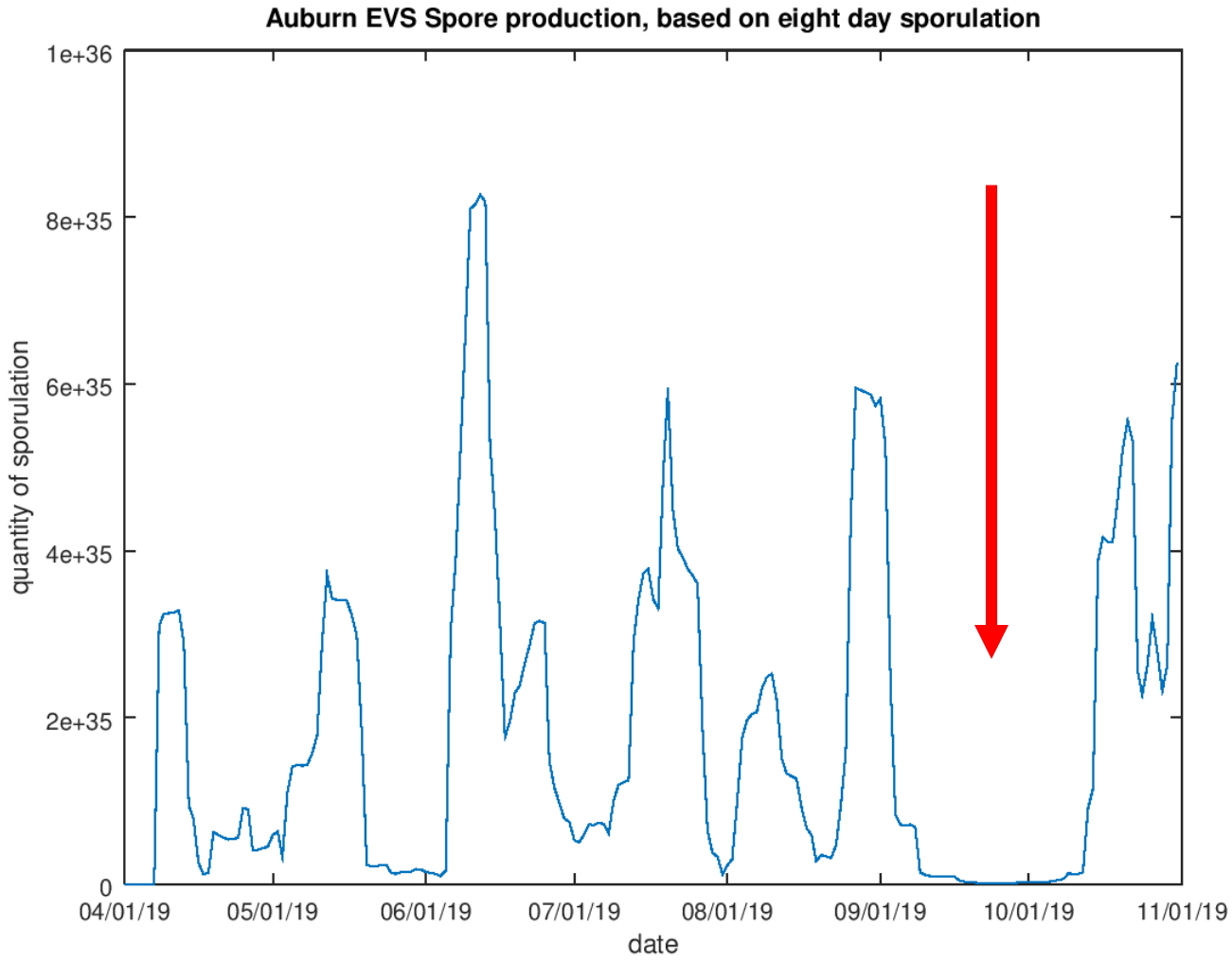
Note high spore count for period starting August 29 and ending September 26



Environmental Suitability for Sporulation

Note from previous slide that time of peak spore capture was from mid September to mid October.

This time overlaps time of lowest environmental suitability for sporulation of *A. flavus* from Batillani model.



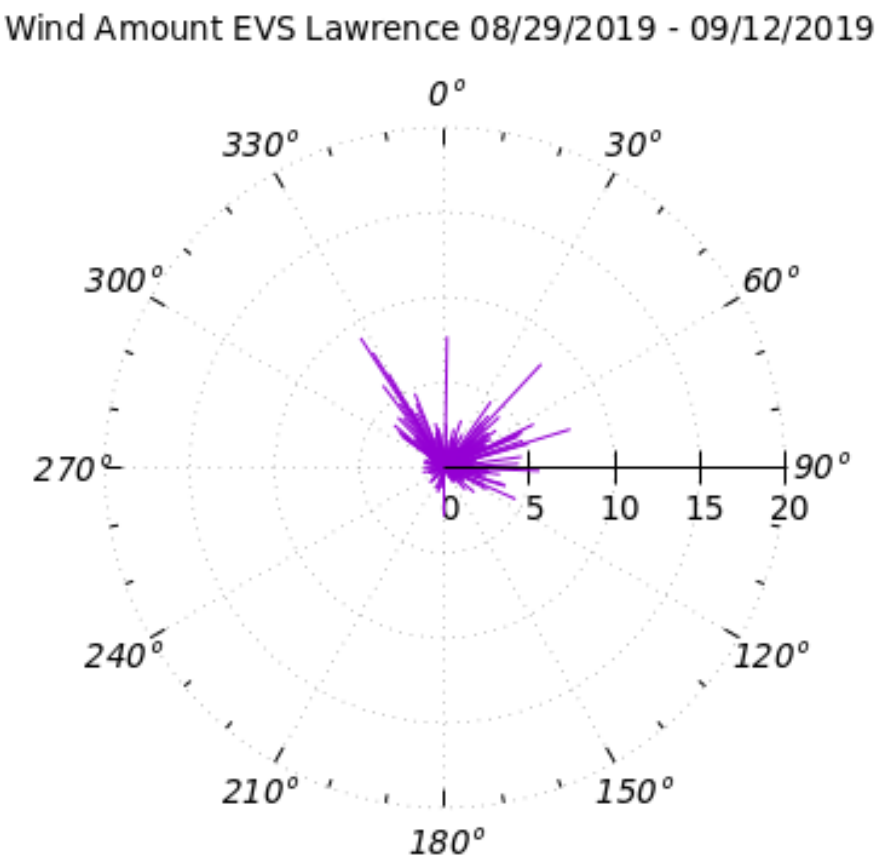
Corn Harvest

According to USDA, harvest time for corn in Alabama is Aug 11 – Sep 20, with an end date of Oct 15

The correlation between corn harvest and *A. flavus* capture suggests that a major source of spores may be corn harvest.

Origin of Spores

- A histogram wind rose based on mesur.io weather suggests that source of spores is from Northwest to Northeast area
- Note: wind direction is where wind comes from



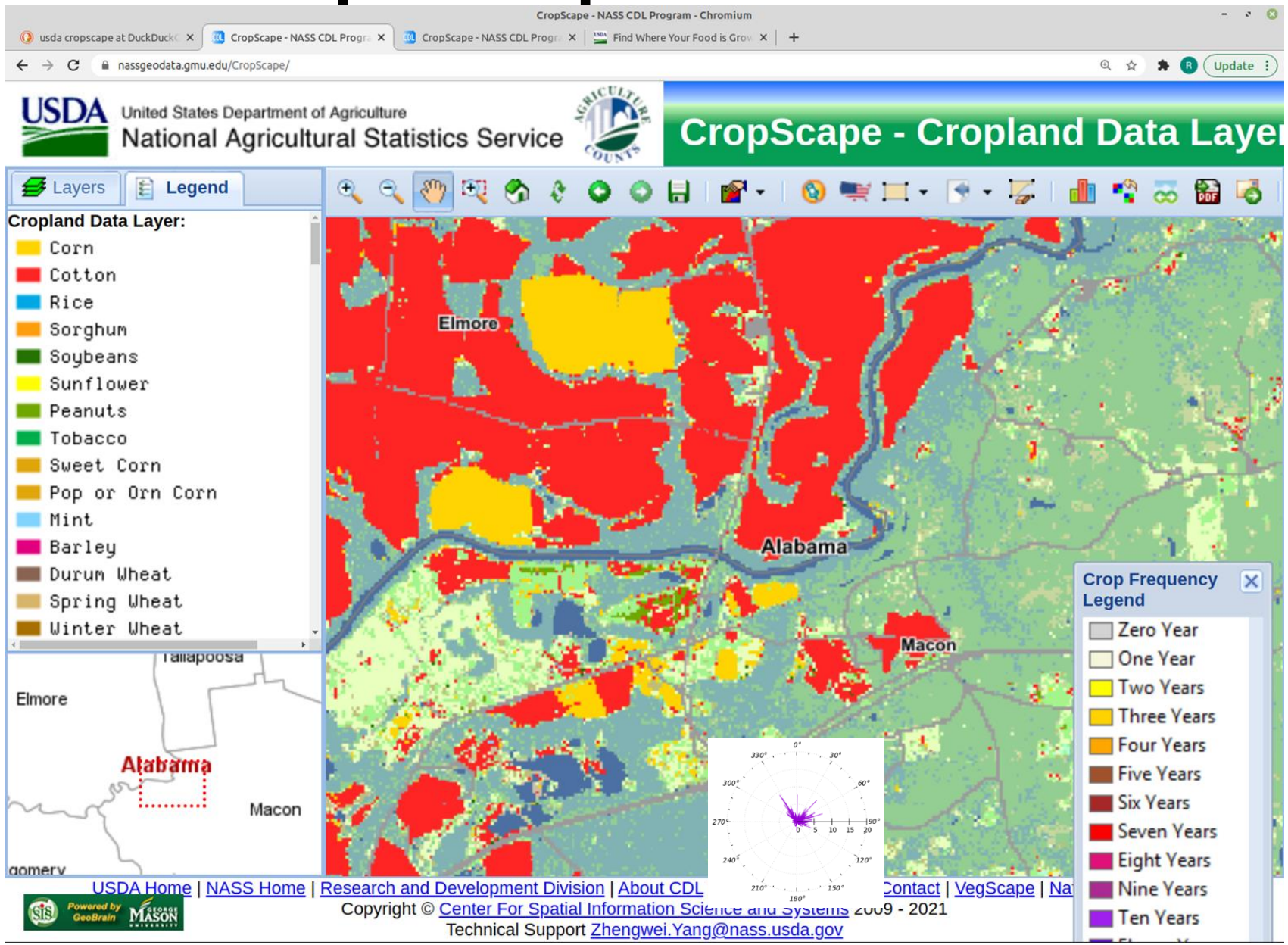
Wind Direction Over Two-Week Spore Sampling Period

USDA Crop Map 2019

- Wind rose is placed over collection site.
- Red is cotton crops, orange is corn crops.
- Corn fields about 3.6 miles Northwest of the Cotton site are potential sources of *A. flavus* spores detected at site.

- Other sites in study have similar results. See Appendix Document.

32°25'23.78"N, 85°53'21.58"W



A. flavus and Corn Harvest

Ear of corn with *A. flavus*

Typical Combine Harvester showing dust plume

Past Analysis of Corn Harvester Dust in Georgia

"The A. flavus group was a major component of combine harvester dusts in all years [1979, 1980, 1982]. As many as 1.2 x 10^6 viable propagules of the A. flavus group were found per m^3 of air in 1980, and these comprised 60 to 80% of the total number of colonies counted. By contrast, less than 20% of the total number of colonies isolated from combine harvester dusts in 1979 and 1982 were the A.flavus group. In those years, there were fewer than 10^5 viable propagules per m^3 of air."

From: Hill, R. A., Wilson, D. M., Burg, W. R., Shotwell, O. L., Viable fungi in corn dust. Appl. Environ. Microbiol. 47:84–87. (1984).

Corn dust behind combine harvester (1980)

	Range	Mean
Aspergillus flavus group	0.7-1.2	0.94
Total aspergilli	0.8-1.2	1.0
Penicillium spp.	0.1-0.2	0.14
Total fungi	1.1-1.6	1.36

Spore density (millions per cubic meter of air)

From: Hill, R. A., Wilson, D. M., Burg, W. R., Shotwell, O. L. (1984). Viable fungi in corn dust. Appl. Environ. Microbiol. 47:84–87.

Corn dust behind combine harvester (1982)

	Mean a.m. samples	Mean p.m. samples
Aspergillus flavus group	0.03	0.02
Cladosporium spp.	0.04	0.21
Fusarium spp.	< 0.01	0.00
Penicillium spp.	0.08	0.17
Yeasts	0.04	0.06
Other fungi	0.01	0.03
Total fungi	0.2	0.49

Spore density (millions per cubic meter of air)

From: Hill, R. A., Wilson, D. M., Burg, W. R., Shotwell, O. L. (1984). Viable fungi in corn dust. Appl. Environ. Microbiol. 47:84–87.

Conclusions

- Corn harvest could be a source of *Aspergillus flavus* spores observed at cotton sites
- The synthesis of data from multiple origins can provide understanding and validation of spore capture data
- Both a pathogen-centric approach and a crop-centric approach are required to understand and validate spore capture data