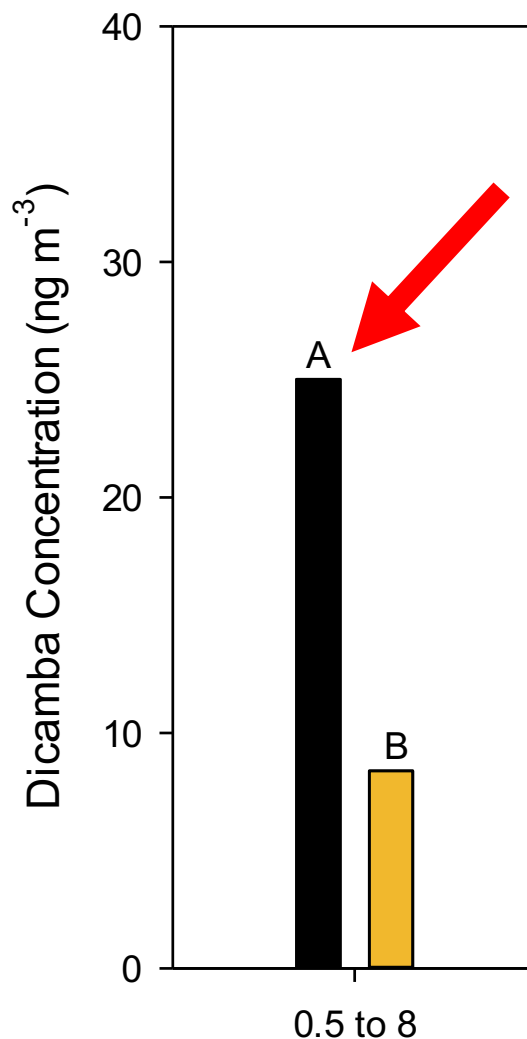


Understanding Weather to Improve Pesticide Application Practices



Mandy Bish
Kevin Bradley
University of Missouri

Using Weather Data to Study Two Types of Aerial Transport



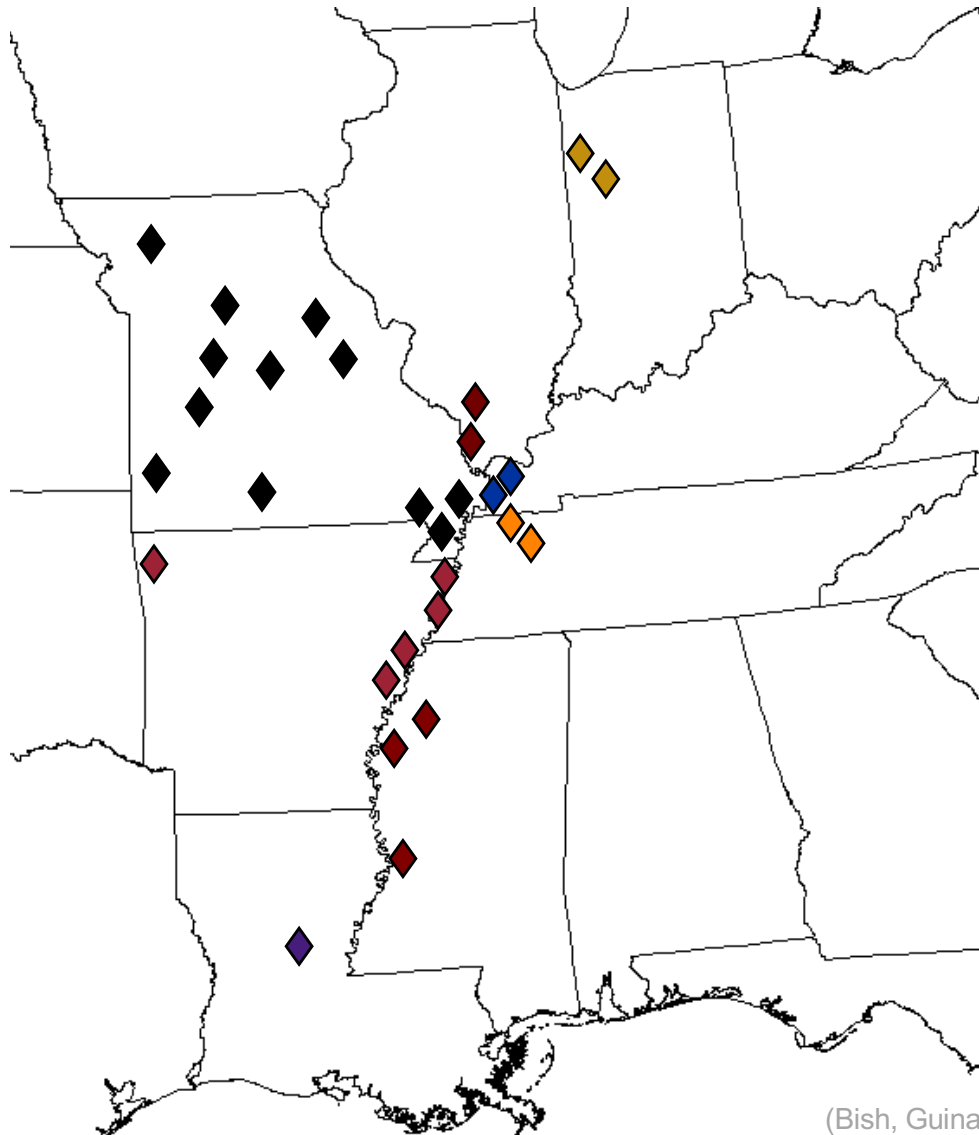
1. INVERSIONS

Spraying during inversion conditions (black bar) compared to daytime conditions (gold bar) results in ~3 x's the dicamba detected in the first 8 hours after application.

For each 1 degree increase in the temperature difference between 120" and 18" air temperatures, dicamba concentration was estimated to increase by 1.67 ng m⁻³.

(Bish, Farrell, Lerch, and Bradley 2019 *Jour. Environ. Quality* 48(6): 1675-1682)

Network of Weather Stations



Pat Guinan
Karla Gage
Lauren Lazaro
Travis Legleiter
Jason Norsworthy
Dan Reynolds
Larry Steckel
Bryan Young



(Bish, Guinan, and Bradley 2019 *Jour. Applied Meteor. & Climatol.* 58: 1973-1992)

Monitoring Inversions

Weather stations were outfitted with identical instrumentation (Campbell Scientific).

Air temperature probes were placed at 18, 66, and 120" above ground level.

Data was recorded every 5 minutes.

Criteria used to define inversions were:

- 18" air temperature < 120" air temperature AND
- 18" air temperature < 66" air temperature AND
- persisted $\geq$ 60 minutes

These criteria will not capture all inversions but:

- were approved by reviewers from the Journal of Applied Meteorology and Climatology (Bish, Guinan, and Bradley 2019 *Jour. Applied Meteor. & Climatol.* 58: 1973-1992)
- will ensure we are working with inversion data sets as we analyze variables that might be useful in forecasting inversions

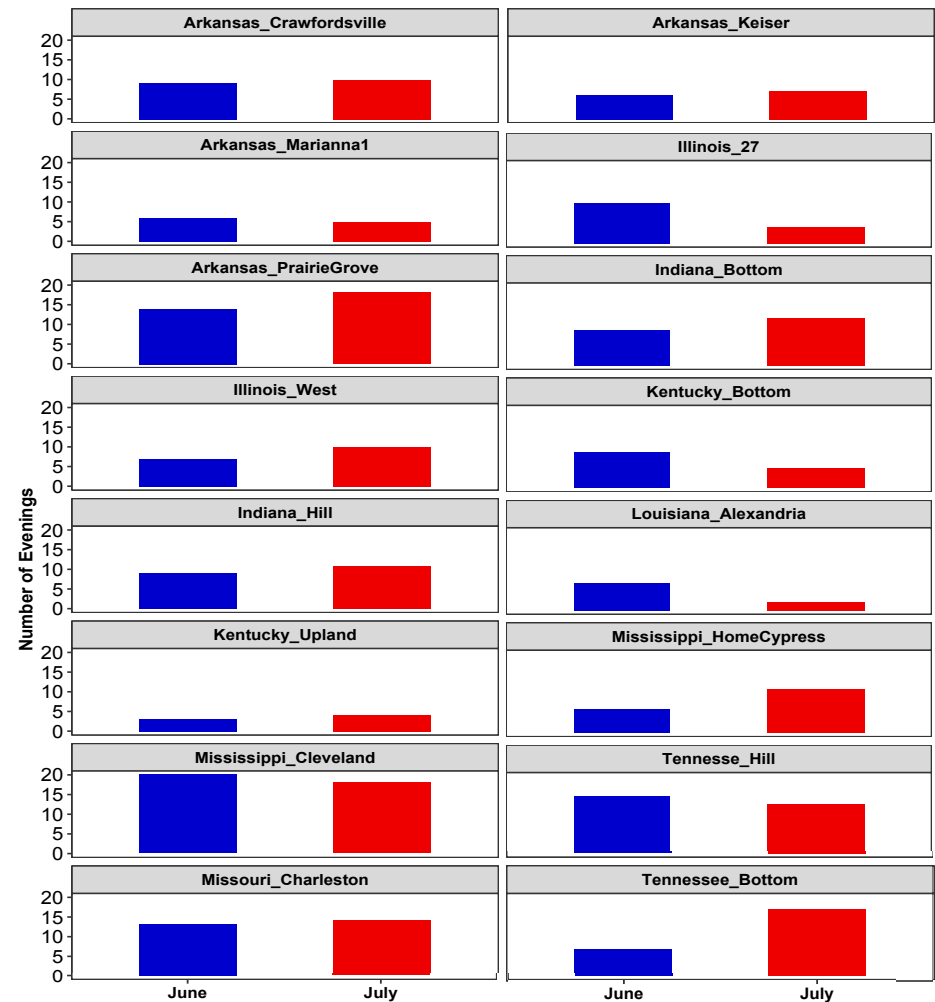
Inversions are Common Across Sites

All sites had inversions during the 2019 growing season.

2019 was unusually wet and thus more cloudy. Cloudy skies should interfere with inversion formations. The number of inversions in 2019 may be lower than in other years.

Microclimates played an important role in inversion characteristics.

An accurate inversion forecasting tool will be challenging to develop across different geographies.



Preliminary data, University of Missouri

Inversions and Microclimates



Two weather stations were placed less than 1 mile apart and less than 100 ft elevation difference.

Inversions formed ~1 to 1.5 hours earlier at the bottom compared to the hill in June and July.



A tree line in the bottom may act to block prevailing winds.

Cool air will settle in the lowest area.

Preliminary data, University of Missouri

Sunset is not Always a Good Predictor

State	May	June	July	August
Indiana Bottom	19:40	20:20	21:10	21:15
Indiana Hill	20:00	20:25	21:35	21:23
Indiana Sunset	20:57	21:19	21:16	20:44
Tennessee Bottom	18:25	16:32	16:40	16:55
Tennessee Hill	17:35	17:38	18:12	17:11
Tennessee Sunset	19:43	20:15	20:13	19:45
Kentucky Bottom*	20:00	20:10	21:00	2:10
Kentucky Hill*	19:15	19:05	20:05	20:10
Kentucky sunset	19:57	20:16	20:15	19:47
Illinois #1*	18:53	19:18	21:10	21:45
Illinois #2*	18:55	19:05	20:12	20:23
Illinois sunset	20:04	20:20	20:18	19:49

*Sites with 1 year of data (2019); all other sites with 2 years of data (2018 and 2019)

Preliminary data, University of Missouri

Sunset is not Always a Good Predictor

State	May	June	July	August
Missouri Hayward**	17:12	17:55	18:25	.
Missouri Charleston	18:05	18:42	18:45	.
Tennessee Bottom	18:25	16:32	16:40	16:55
Tennessee Hill	17:35	17:38	18:12	17:11
Arkansas Prairie Grove*	18:05	18:35	18:30	18:42
Arkansas Marianna 1*	18:18	18:27	18:45	19:18
Arkansas Keiser*	18:18	18:20	18:40	18:15
Arkansas Crawford*	17:45	18:10	18:45	18:15
Mississippi Cleveland*	17:45	17:57	18:45	18:20
Mississippi Home Cypress*	19:27	18:35	17:38	18:30

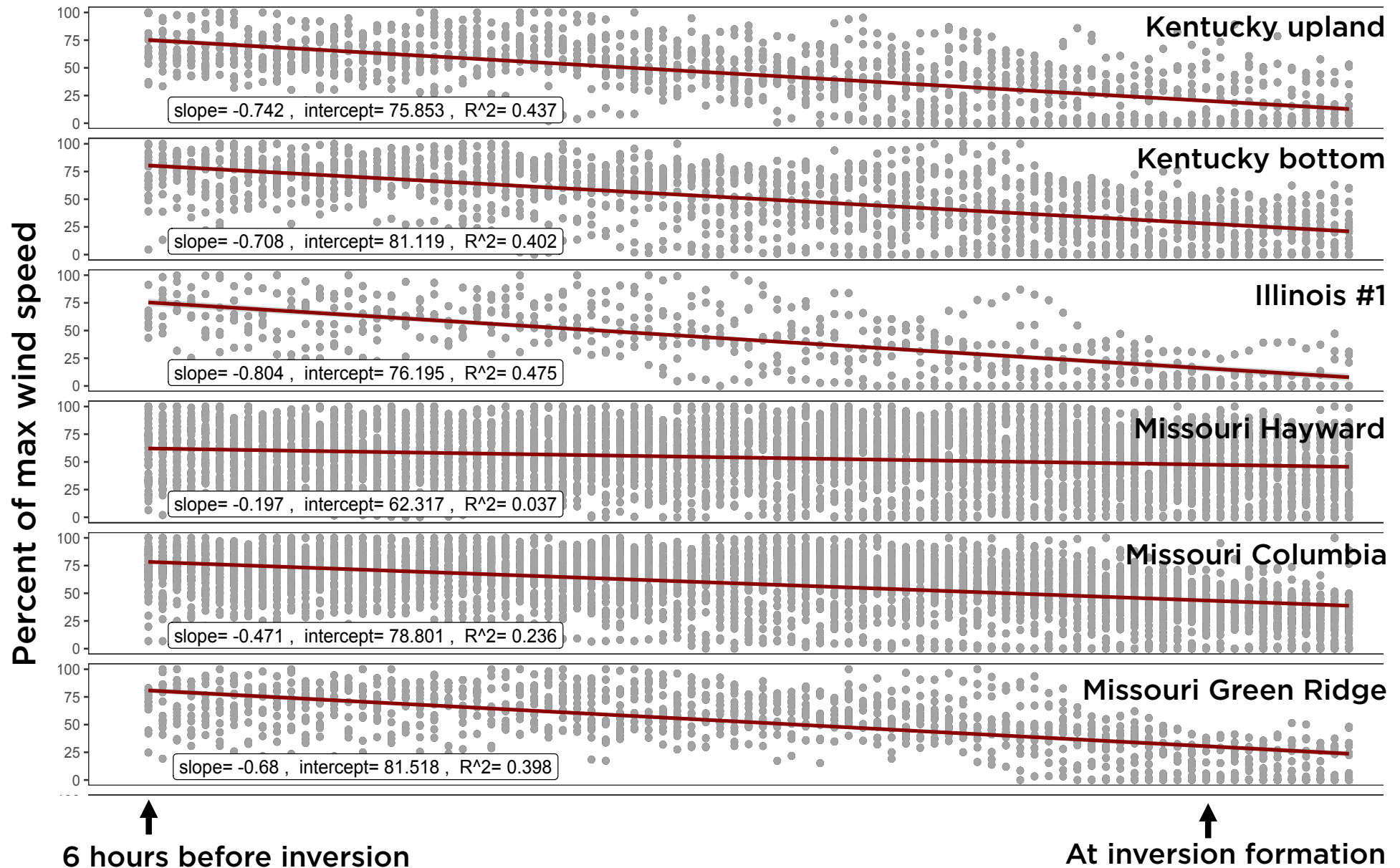
*Sites with 1 year of data (2019)

**Site with 4 years of data

All other sites with 2 years of data (2018 and 2019)

Preliminary data, University of Missouri

Reduction in Wind Speed may be a Good Predictor for Some Locations?



Preliminary data, University of Missouri

A Few Summary Thoughts on Inversions

They are common across geographies.

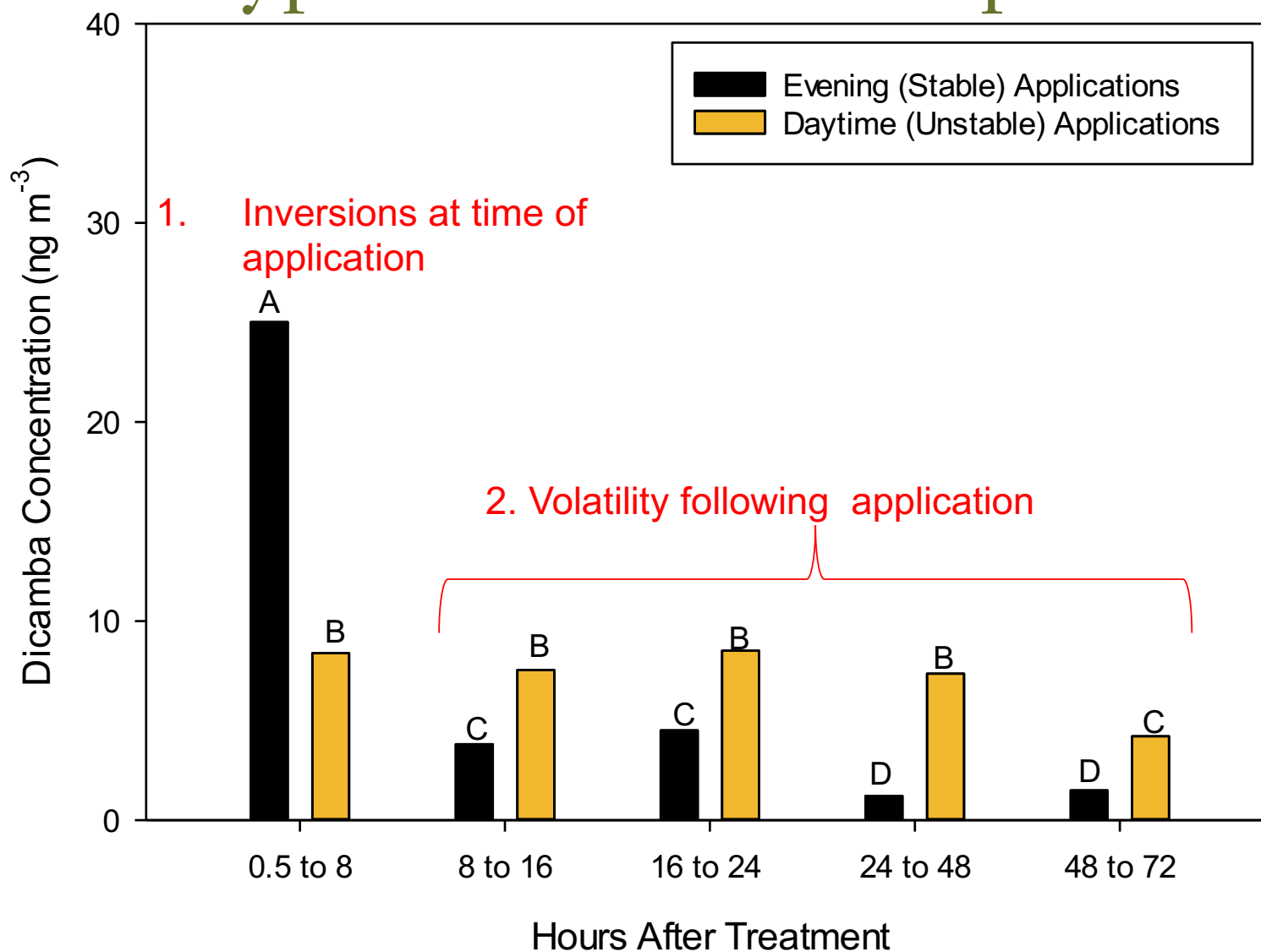
Microclimates are going to influence inversion characteristics: formation time, dissipation time, intensity.

Forecasting apps will likely work well for some geographies but not for all.

Training an applicator on the signs of inversions is probably, for now, the best option.



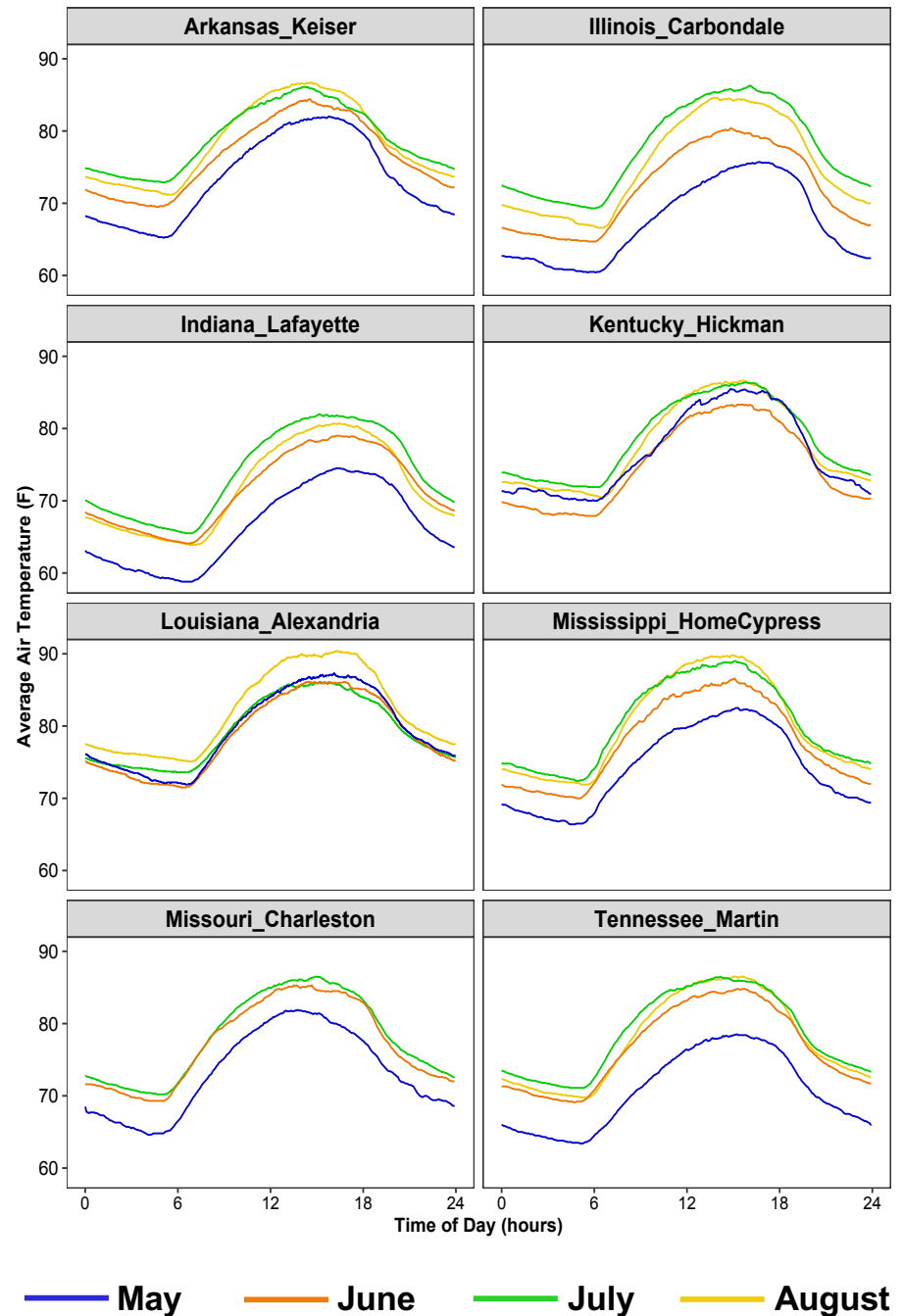
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Average Air Temperatures 2019

Daily air temperatures exceeded 85 °F in June, July, and August at multiple locations.

However, air temperatures were not extreme relative to some geographies with less dicamba OTM.



Relative Humidity (2019)

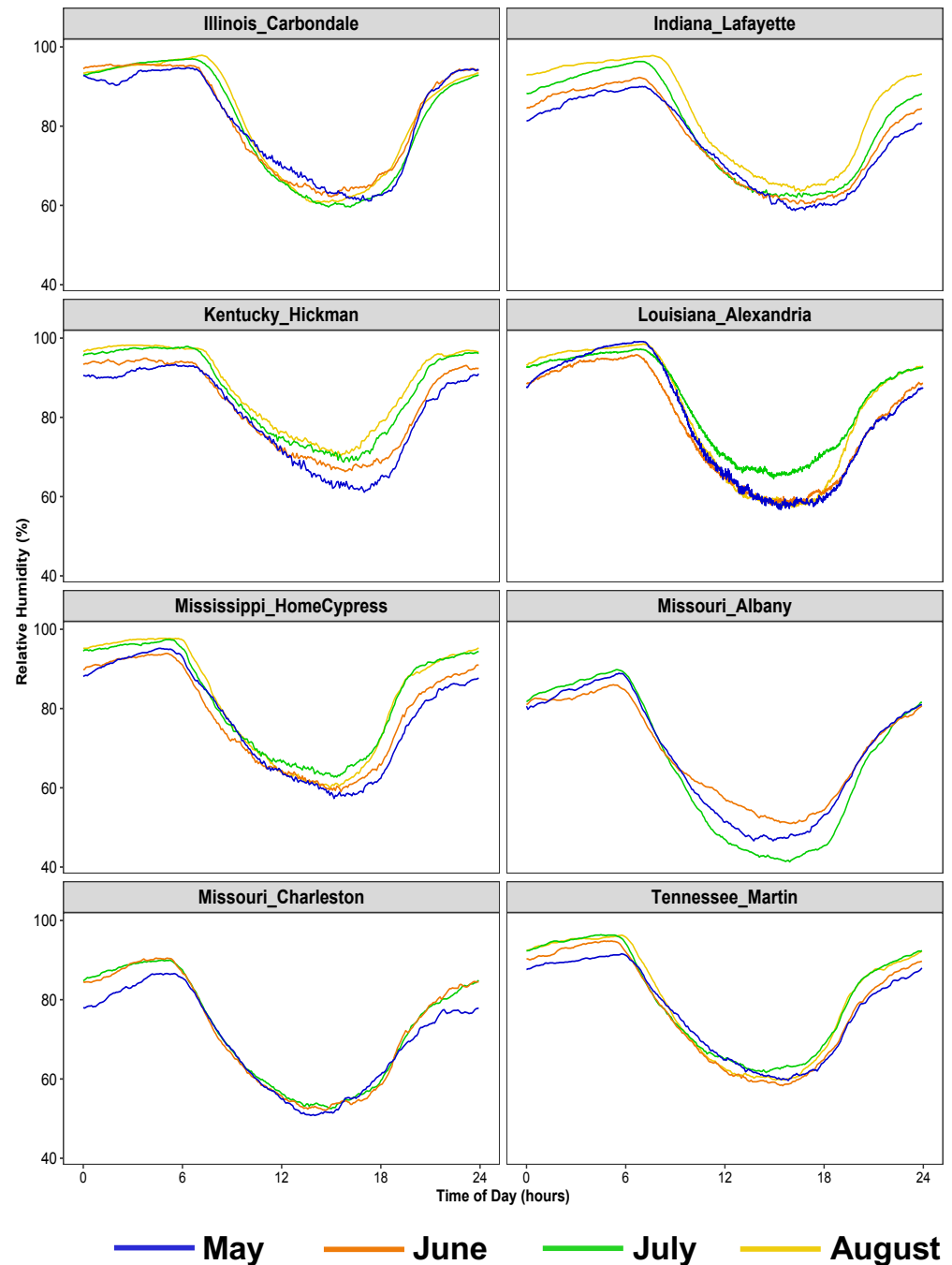
Rarely did relative humidity drop below 50%.

The trend is consistent with lowest relative humidity occurring from 12 to 5 or 6 PM.

This corresponds to peak transpiration and evaporation activity of plants.

Similar to some geographies with less dicamba OTM.

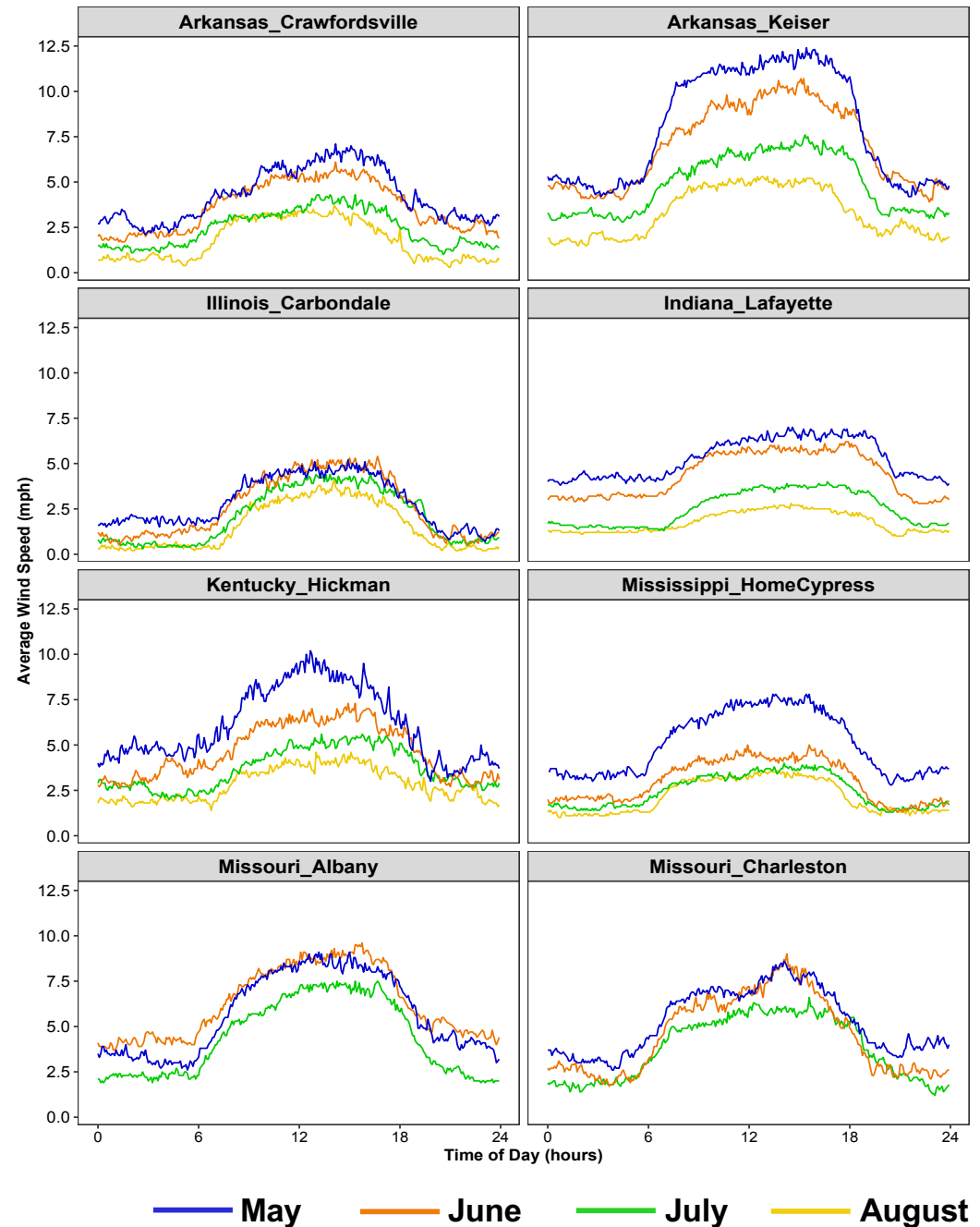
...Is there enough wind to disperse what is volatilizing off plants?



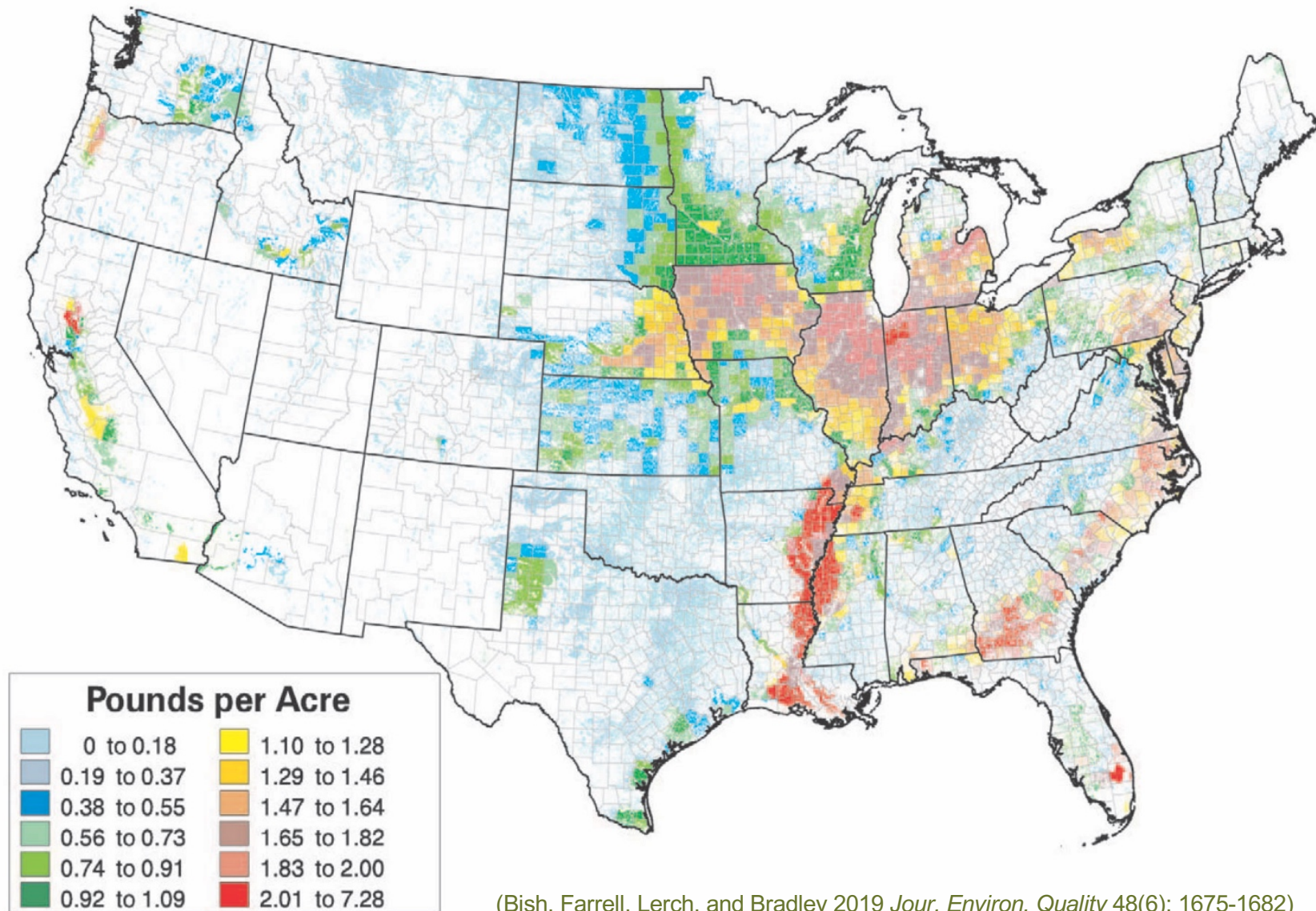
Average Wind Speed (2019)

An average wind speed of 10 mph at 10' estimates to approximately 3.4 mph at 3' above the ground.

Still working to get wind data from non-problematic locations....



Is there enough wind to sufficiently disperse all the dicamba being applied?



Questions?



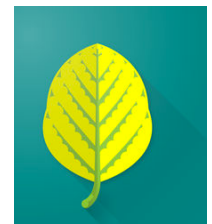
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