# 2,4,-D, DICAMBA, AND HERBICIDE DRIFT

**Diagnosing Herbicide Drift in the Field**

**Results of Herbicide Tissue Analysis**

**What We Have Learned and Thoughts Going Forward**

# INJURY SYMPTOMS WITH GROWTH REGULATORS

- Twisted and downward cupping of leaves

- Narrow strap-like leaves on new growth

- **Root uptake is more damaging**

# SYMPTOMS ASSOCIATED WITH PHENOXY CHEMICAL HERBICIDES

# SYMTPOMS ASSOCIATED WITH GROWTH REGULATORS

- Root uptake of dicamba causes leaves to cup upward instead of downward

# HERBICIDE INJURY LOOK-ALIKES

- Mites, insects, diseases
- Adverse weather
- Soil compaction
- Drought
- Root stress

# HERBICIDE INJURY LOOK-ALIKES

- Improper soil pH
- Misapplied fertilizers
- Genetic mutations
- De-icing salts

# DIAGNOSING HERBICIDE INJURY

- **Know symptoms** of herbicides on specific plants

- **Mode of action, fate in soils, and dosage applied**
  - Dicamba can be taken up by tree roots in treated areas
  - Know what other herbicides were applied

- **Timing**
  - Damage usually occurs within days after exposure
  - Symptoms may develop several weeks after exposure
  - Later, if tree roots grow into a treated site

# DIAGNOSING HERBICIDE INJURY

- **Patterns on adjacent plants**
  - Look for similar damage patterns
  - Look for damage on other different plants
- **Location**
  - Injured plants relative to herbicide application
  - **Soil sterilants will move in direction of water flow**
  - Weather at application time

# DIAGNOSING HERBICIDE INJURY

- **Recovery**
  - Affected by overall plant vitality
  - Amount of herbicide received
  - Type of herbicide
  - Growing conditions after contact

- **New growth usually will appear normal**
- **Symptoms may persist for 2 to 3 seasons**
- **Heavy dose may kill plants**

# DIAGNOSING HERBICIDE INJURY

- Contact herbicides cause leaf spotting
- Total tissue death is uncommon
- Plants absorbing soil sterilant may die
- Timing of exposure is important
- **Exposure late in year is not as injurious**

# PLANTS SENSITIVE TO GROWTH REGULATORS

- Apple
- Forsythia
- Horse chestnut
- Redbud
- Sycamore
- Box elder
- Grape
- Norway maple
- Rose
- Dogwood
- Honeylocust
- Petunia
- Siberian elm

# PLANTS EXTREMELY SENSITIVE TO HERBICIDES

- **Extremely Sensitive**

| | | |
|---|---|---|
| • Grapes | Lima bean | Southern Pea |
| • Snap bean | Soybean | Tobacco |
| • Peach | Elderberry | Dogwood |
| • Oaks | Viburnum | |

# PLANTS VERY AND MODERATELY SENSITIVE TO HERBICIDES

- **Very Sensitive**
- Cotton
- Tomato
- Pumpkin
- Pepper
- Watermelon
- Squash

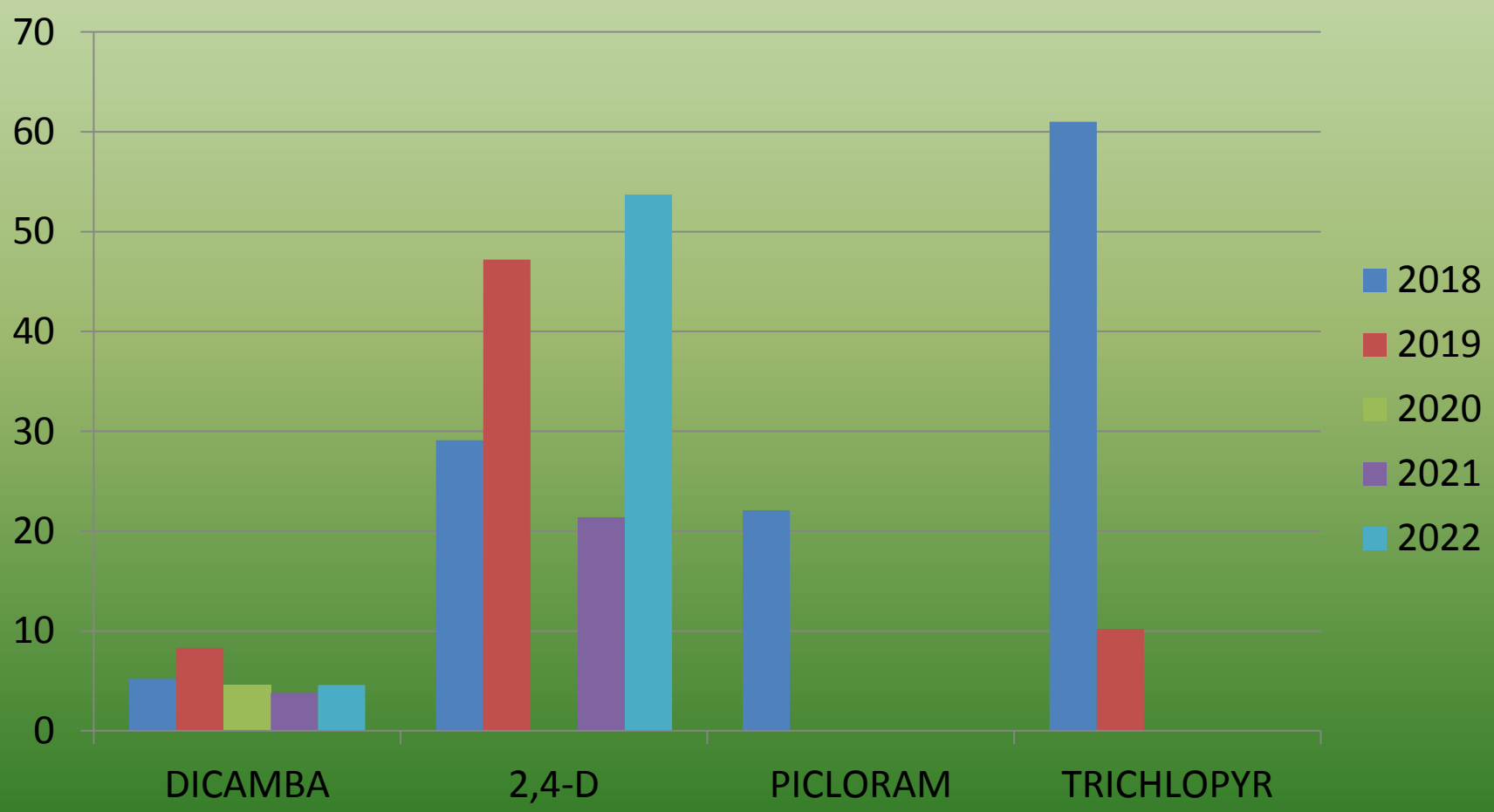
- **Moderately Sensitive**
- Cantaloupe
- Apple
- Redbud
- Cucumber
- Maple
- Rose

# PLANTS WITH LOW SENSITIVITY TO HERBICIDES

- **Low Sensitivity**
- Peanut
- Cabbage
- Mustard
- Walnut
- Raspberry
- Sweetgum
- Hydrangea
- Broccoli
- Kale
- Turnip
- Pecan
- Strawberry
- Crabapple

# HERBICIDE LEAF TISSUE SAMPLES 2018-2022

(Herbicide concentrations in ppb)



# 2023 MSN Herbicide Leaf Tissue Results (ppb)

| Chemical (ppb) | White Oak (N=4) | N. Red Oak (N=2) | Bur Oak (N=4) | Swamp White Oak (N=4) |
|---|---|---|---|---|
| **2,4-D** | **18.7 (8.3-37.9)** | **86.0 (85.3-86.8)** | **14.1 (10.8-19.3)** | **25.4 (15.1-31.2)** |
| **2,4,DP** | <5 | ND | ND | ND |
| Dicamba | 4.6 | ND | 1.5 | 1.0 |
| Clopyralid | 6.4 | <5 | 20.0 | 8.1 (<5-11.6) |
| **Triclopyr** | **200.5 (155-236)** | **ND** | **288.0 (174-395)** | **49.8 (29.2-84.2)** |

# Illinois Mason State Nursery (MSN)

# 2023 MSN Herbicide Drift Damage Timeline

- **Ag field North side of nursery (Damage seen mid-July)**
  - Field in pasture with no barriers or windbreaks
  - **Very heavy damage to white and bur oaks in center of plot**
  - **Crossbow?** (2,4-D + Triclopyr) for woody plant control
  - **2,4-D** (18.7 ppb), and **Triclopyr** (200 ppb) detected in leaf tissue
- **Ag field on South side of nursery (Sprayed on 20 July)**
  - Unknown herbicide
  - Conifer windbreaks on west and south sides
  - **Moderate damage** to northern red oaks
  - **2,4-D** (86.0 ppb) detected in leaf tissue

# 2023 MSN Herbicide Drift Damage Timeline

- **Ag field East side of nursery (Sprayed 14 June)**
  - 2,4-D suspected
  - **No windbreaks**
  - Temperature inversion occurred and damage to wildflowers
  - Swamp white oaks damaged [2,4-D (25.4 ppb), and Triclopyr (49.8 ppb detected in leaf tissue]
- **Ag field West side of nursery (Sprayed on 20 July)**
  - Sprayed following wheat bean rotation (unknown herbicide)
  - **IDA considered it might be "Liberty" (glufosinate-ammonium)**
  - **Damaged many plants except conifers**, complaint filed with IDA
  - **Partial conifer windbreak on north half of plot**
  - **KCT damaged** [Only 2,4-D (34.9 ppb) detected in leaf tissue]
  - **White and bur oaks damaged [**2,4-D (18.7 to 14.1 ppb), and Triclopyr (200 to 288 ppm), respectively detected in leaf tissue]

# Herbicide Drift Damage – MSN

## (N. Red Oak-Left and White Oak-Right)

# "Major Take Homes"
## 2022 vs. 2023

- **Location, Location, Location!**
- Cropping systems and application dates
- Crop rotation is major factor in herbicide damage and timing of damage
- Hard to document damage unless present at time of application
- **2,4-D:** Factor in 2023, but residues 50% lower than in 2022
- **Dicamba** residues: 50% lower than 2022
- **Triclopyr** residues: 3X higher than 2022
- **Oomycete levels low except for NROs**

# “Major Take Homes”
## 2022 vs. 2023

- **Drought combined with extensive herbicide damage resulted in** leaf scorch and deformation on white oaks
- **Outbreak of oak leaf skeletonizer** on white oak and bur oaks added to the misery
- **Soils nutrient deficiencies (i.e. Ca, P) and presence of root-rotting pathogens** may contribute to tree decline

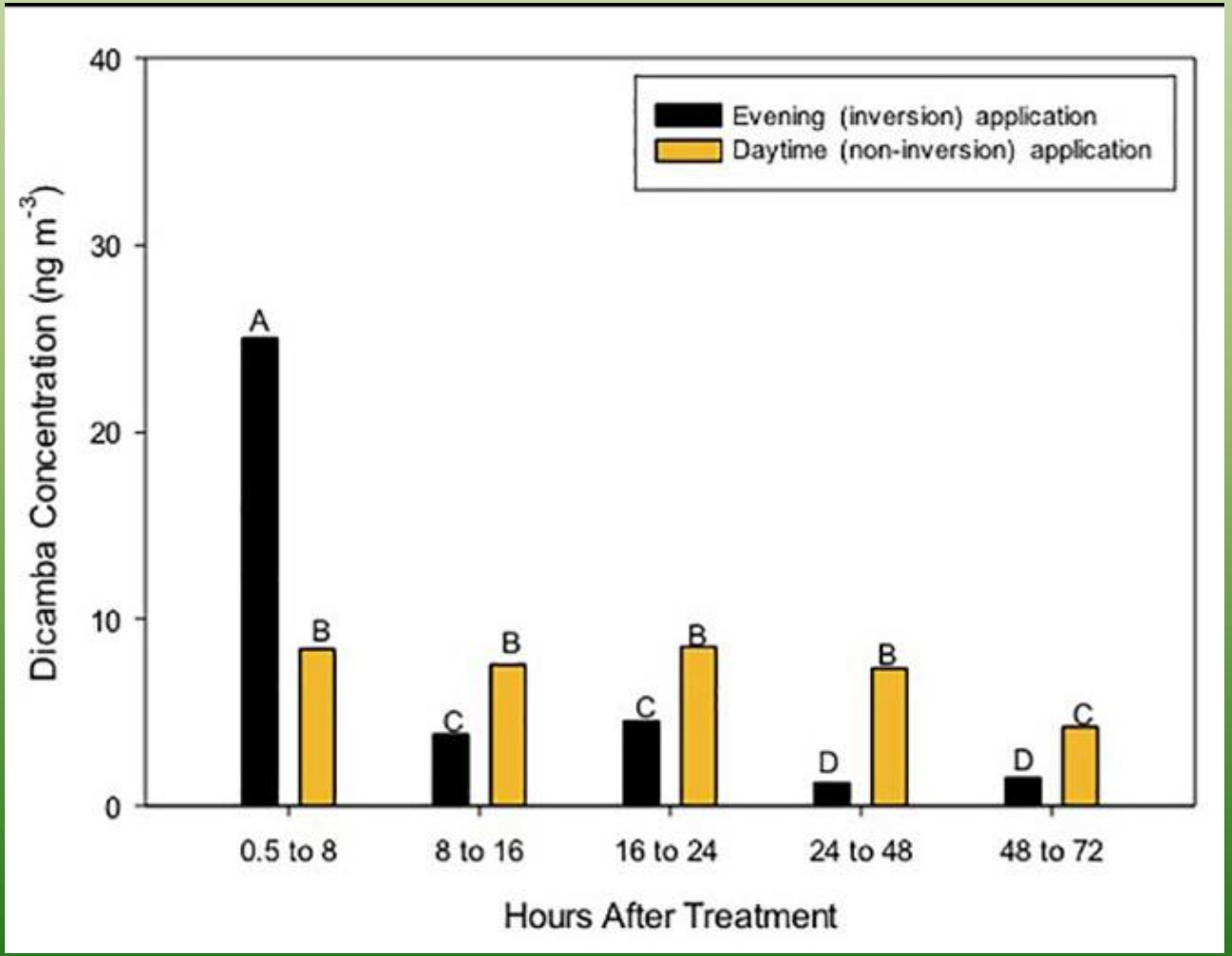
# FIVE THINGS WE HAVE LEARNED ABOUT DICAMBA

*Bradley and Bish: University of Missouri –Extension*

*9 April 2019*

- **1. Dicamba can be detected in air following treatment**
  - Nothing new, but dicamba products are volatile
  - **Questions remaining are:**
    - How much volatility results in off-target injury?
    - Can we do anything to minimize off-target injury?
  - Highest concentrations occur in first 8 hours post application and up to 72 hours
  - Higher concentrations in evening hours during stable conditions favoring temperature inversions

**Figure 1:** Dicamba air concentrations following application during evening, inverted air temperature conditions (**black bars**) and daytime, non-inverted air temperatures (**gold bars**).



- **2. Addition of glyphosate and spray tank pH matters**
  - Lowers pH of spray solution
  - With low pH, dicamba may dissociate to acid form which is the most volatile form
  - Avoid a spray mix of less than 5

- **3. Soil pH matters**
  - The lower the soil pH the more volatility occurs with dicamba formulations
  - May be an important piece of the over all puzzle

**Figure 2:** Influence of soil pH and dicamba formulation on soybean injury as a result of volatility. Results are combined across two experiments conducted in 2018. Bars followed by the same letter are not different.

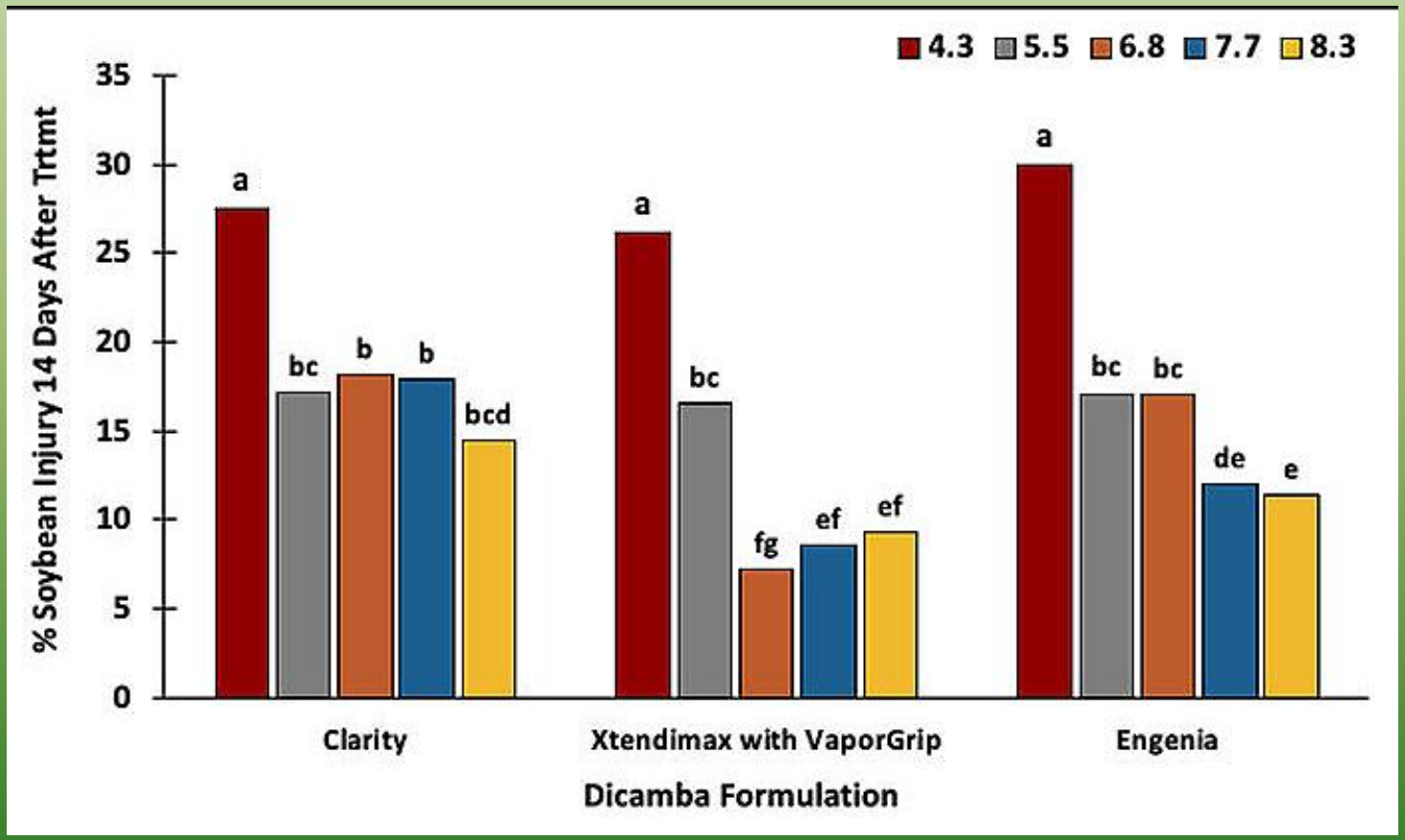
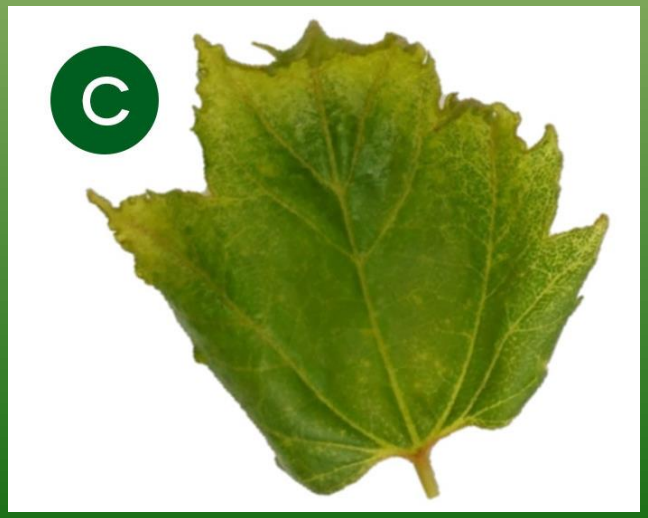


**Figure 3:** Response of peach **(A), pin oak (B), maple (C), elm (D), and grape (E)** to 1/20th of the standard use rate of dicamba (0.025 lb ae/A) or dicamba + glyphosate (0.025 + 0.05 lb ae/A). **This rate is representative of what can occur during a physical drift event.**







- **4. Temperature inversions are common**
  - **Can occur from April to July**
  - **Begin forming before sunset**
    - April: 5:00 and 6:30 pm
    - May : 5:30 and 6:50 pm
    - June: 6:00 and 7:00 pm
    - July: 6:00 and 8:00 pm
  - Field surrounding influence time of inversions
    - Form more quickly and earlier in areas where wind is obstructed
  - Cool air will gravitate to the lowest point in a field
  - Dicamba may move with cool-stable air masses
  - Dicamba can be detected in air following applications during inverted air temperatures
  - Smoke bombs are good indicators of inversions

**Figure 1:** Network of inversion monitoring stations that are tracking inversions at heights relevant to ground pesticide applications. **Counties in blue** indicate the 3 original inversion monitoring stations which were equipped in 2015. **Counties in red** indicate newer inversion monitoring stations that went online in 2017 and 2018.

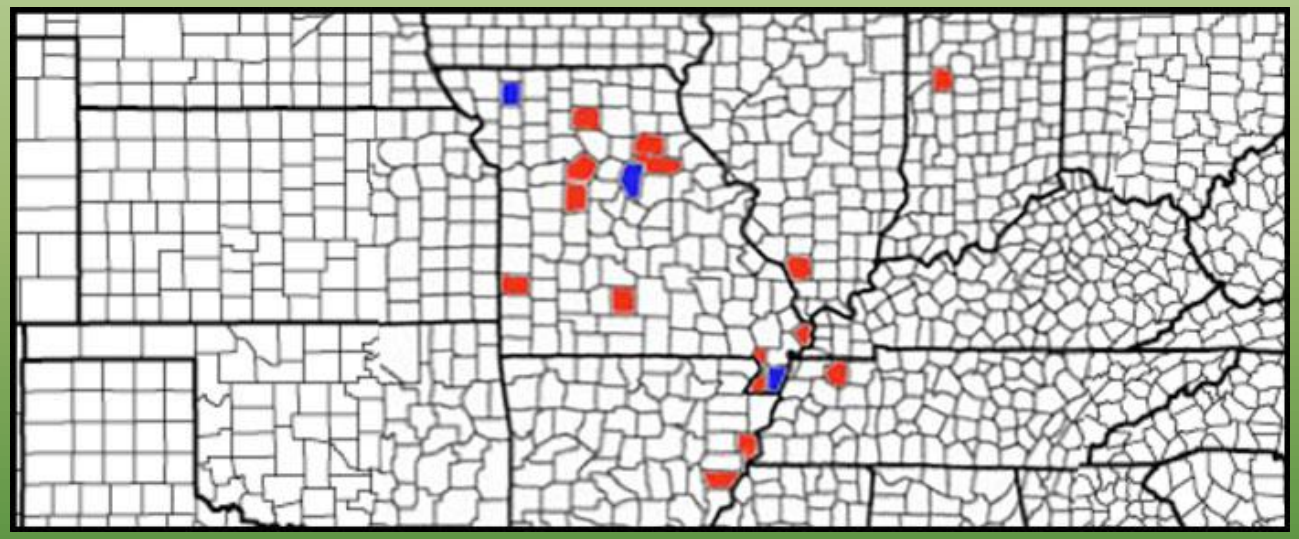


**Figure 2:** The percent of evenings in June and July of 2018 that inversions formed. An inversion was defined as air temperature at 18" being cooler than air temperature at 120".

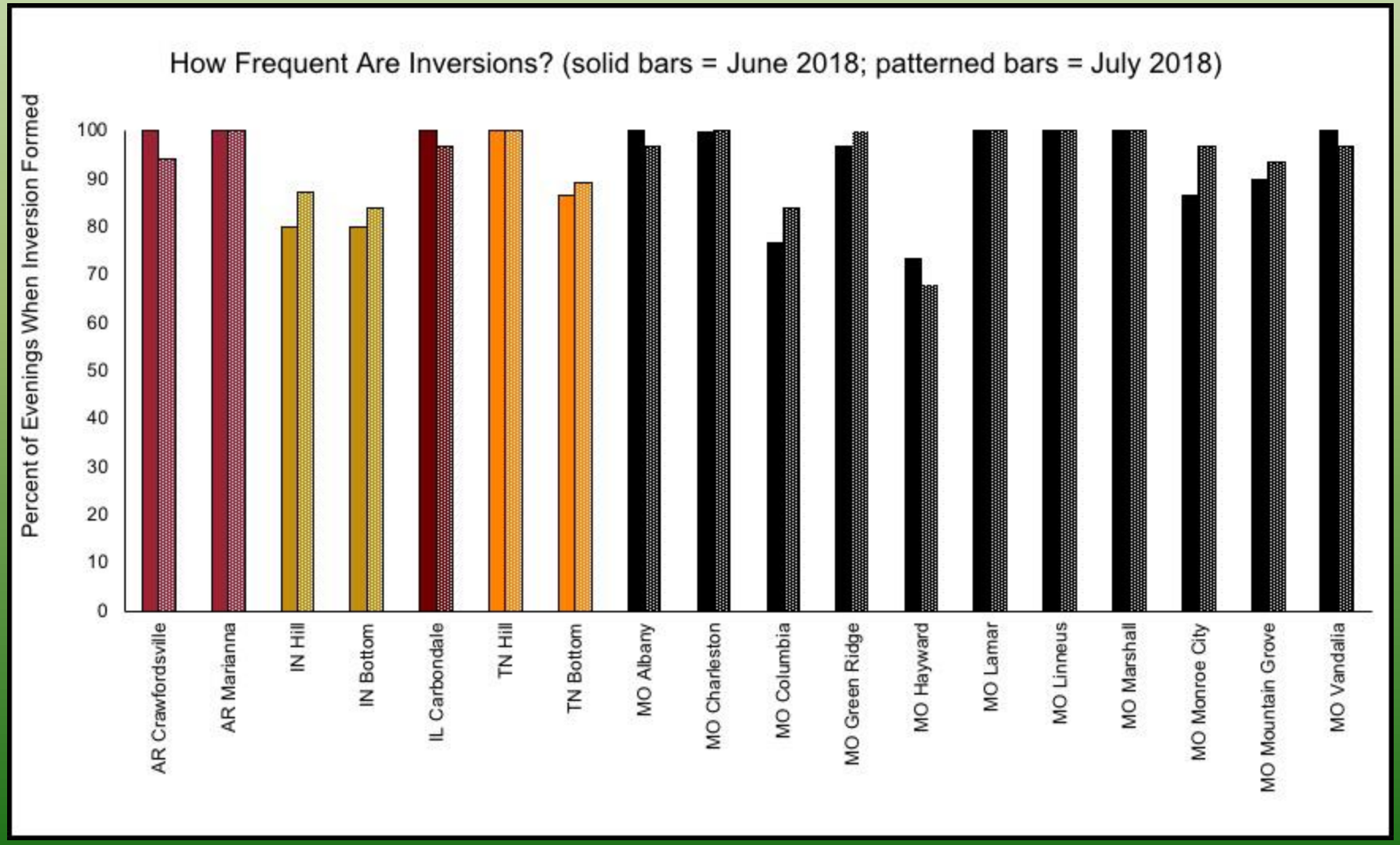
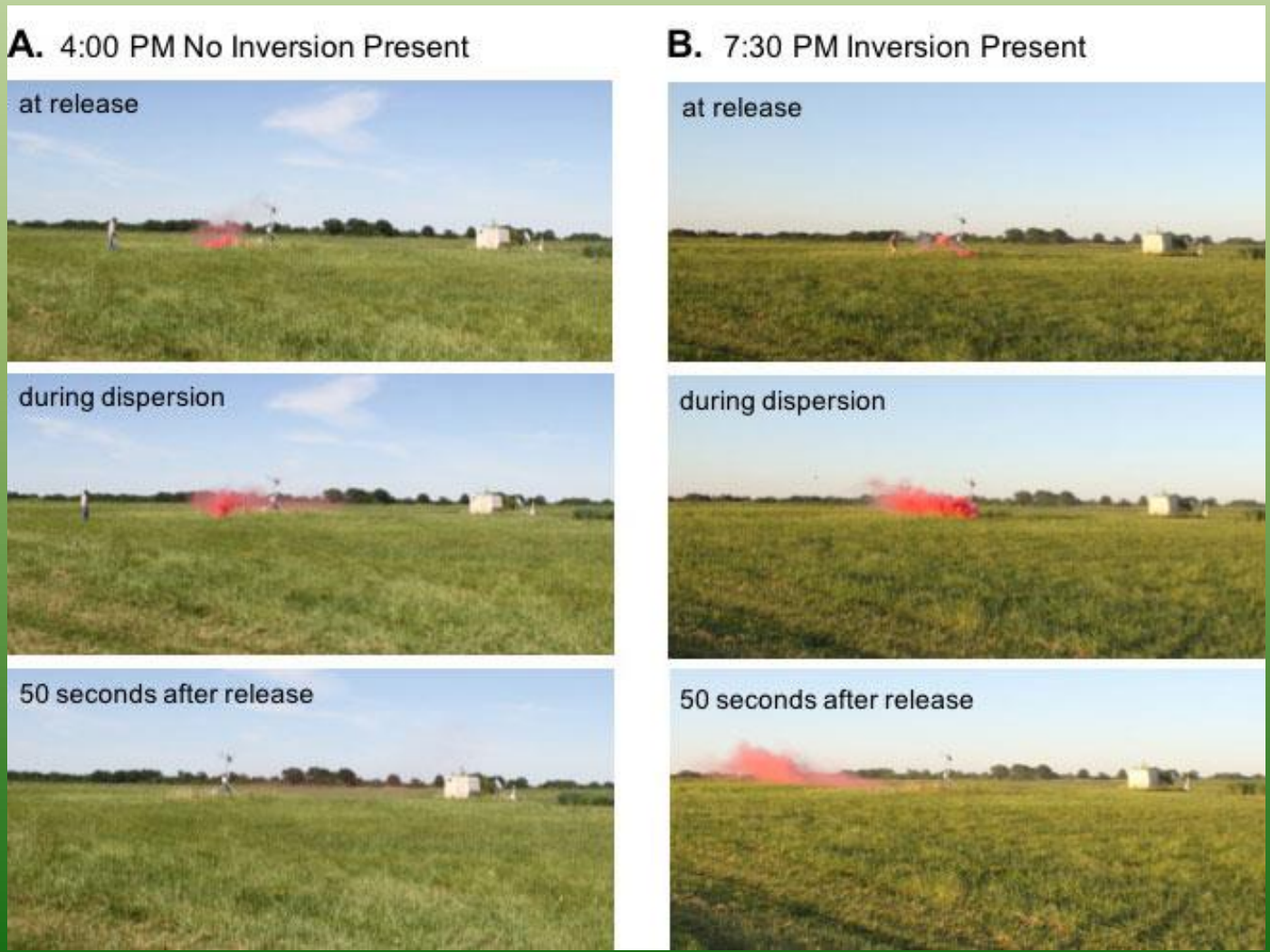


**Figure 3:** Obstructions to wind can result in inversions forming more rapidly. In this example the **star** marks the location of the inversion-monitoring weather station. A tree row 125' to the south of the weather station provides obstructions to the prevailing southern wind. Inversions typically form earlier at this location compared to other sites.

**Figure 5** Smoke bombs can serve as visual indicators of inverted air temperatures. When temperatures are not inverted **(A)**, the smoke bomb dissipates. When air temperatures are inverted **(B)**, the red smoke lingers and suspended particles can be moved by wind. The weather station monitoring the air temperatures is in the middle of each photo as a height reference; it is 120" in height.



- **5. Burndown applications of dicamba products can still cause problems**
  - These herbicides are **less likely** to move off-target and cause injury when applied as a burndown in April and May
  - In 2018, more calls and complaints were received in April and May injury to specialty crops and trees than at any other time during the season
  - Damage appeared to coincide with bud break and leaf unfolding (i.e. April and May) for many tree species

# END OF PRESENTATION