Comparison of herbicide spray drift from ground and aerial applications

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2022 NAAA Ag Aviation Expo

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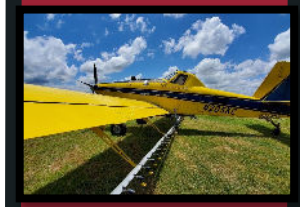
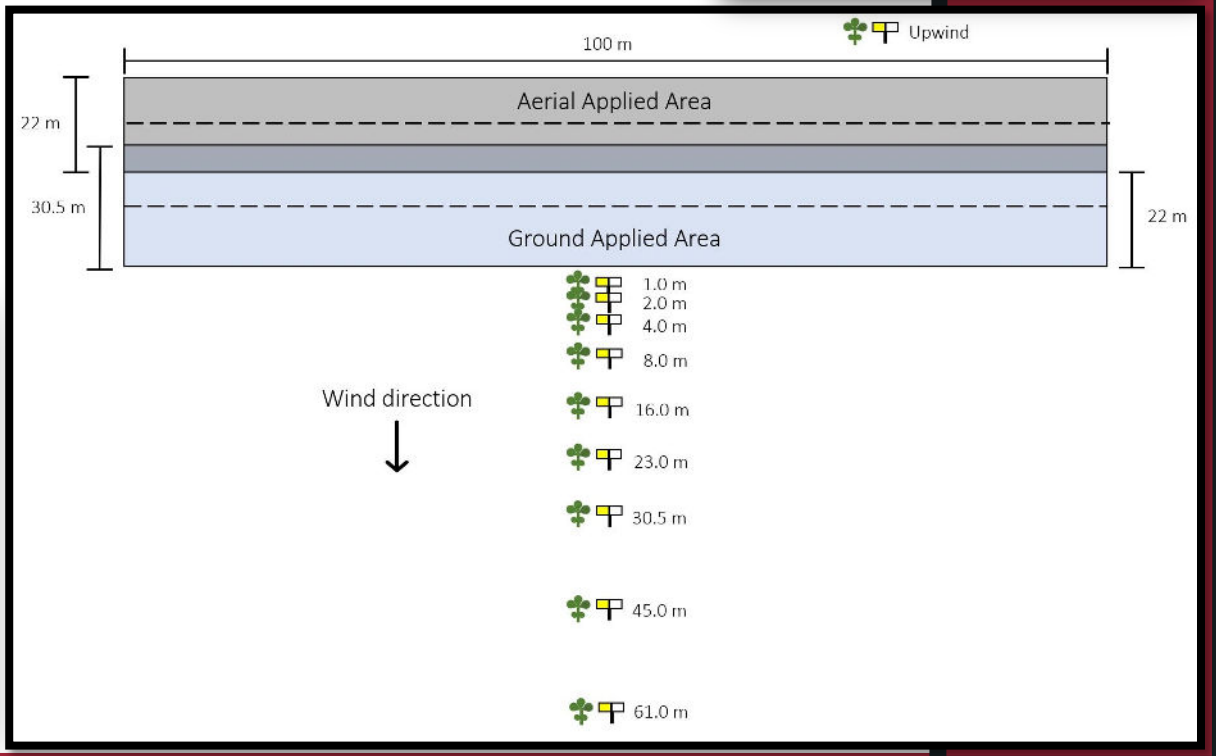
Knoxville, TN
Dec. 5, 2022

Spray Drift Background



Loyant Drift Study

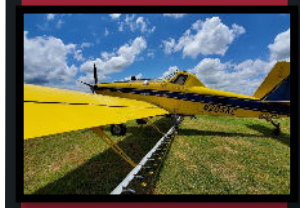
- Field drift study conducted near Stuttgart, AR
- 9 downwind (1, 2, 4, 8, 16, 23, 30.5, 45, and 61 m) **(3.3, 6.6, 13.1, 26.2, 52.5, 75.5, 100.0, 147.6, and 200 ft)** and one upwind (nontreated control) collection stations
- Collection stations equipped with one 76.2 x 50.8 mm (2 x 3 in) **water sensitive card**, one 101.6 x 101.6 mm (4 x 4 in) **plastic Mylar card**, and a **soybean plant** (V3-V4 growth stage) as a bioindicator
- To adjust for spray swath displacement from the ag aircraft, a 22 m (72 ft) upwind swath adjustment was utilized



Application Info

- Ground Sprayer:
  - → Case 5550 AimPoint
  - → 30.6-m (100 ft) boom width
  - → 0.9-m (36 in) boom height
  - → 276 kPa (40 PSI)
  - → ER11010 nozzles (Wilger)
  - → 32 kph (20 mph) speed
  - → Coarse spray classification
  - → 94 LPH (10 GPA)

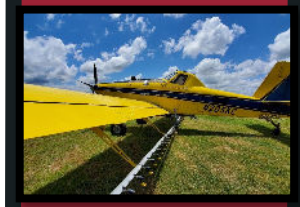
- Agricultural Aircraft:
  - → AirTractor 802A
  - → 22-m (72 ft) swath width
  - → 4.6-m (15 ft) flight height
  - → 0° deflection angle
  - → 345 kPa (50 PSI)
  - → CP09 straight stream nozzles (CP Nozzles, Transland)
    - → Orifice sizes alternated in pattern of 0.78 – 0.78 – 0.125
  - → 233 kph (145 mph) airspeed
  - → Coarse spray classification
  - → 70 LPH (7.5 GPA)



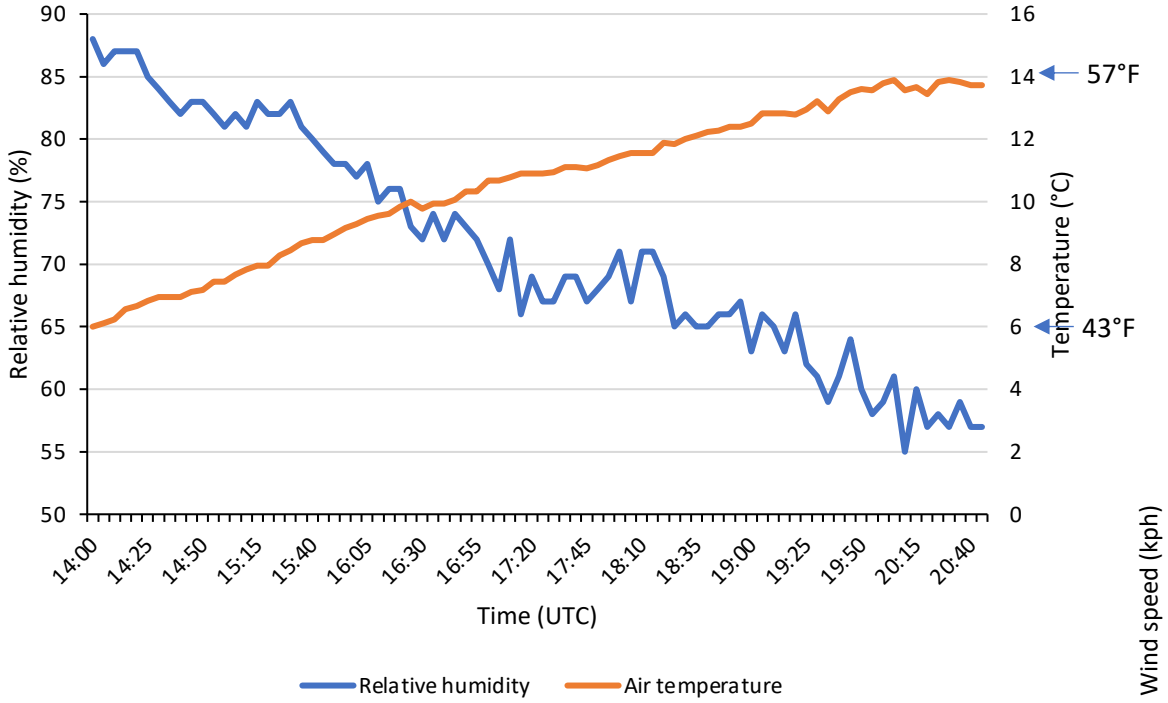
- Florpyrauxifen-benzyl (Loyant) (29.4 g ai ha^{-1}; 16 fl oz/ac) + MSO (0.6 L ha^{-1}; 0.5 pt/ac) + 2 g L^{-1} PTSA dye tank-mix
- 10 individual replicates (spray passes) each for ground sprayer and ag aircraft

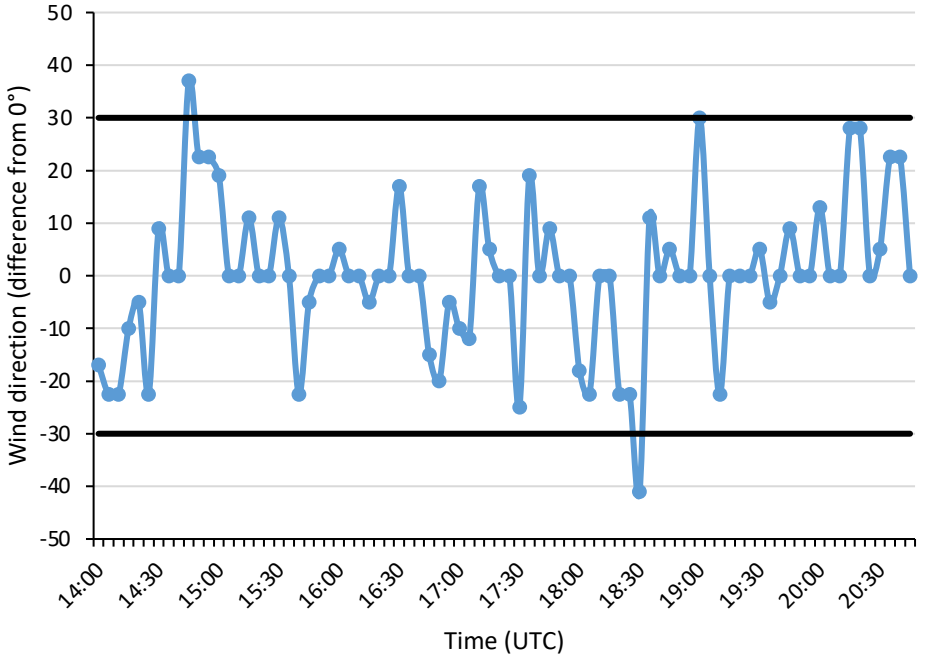
Droplet Size

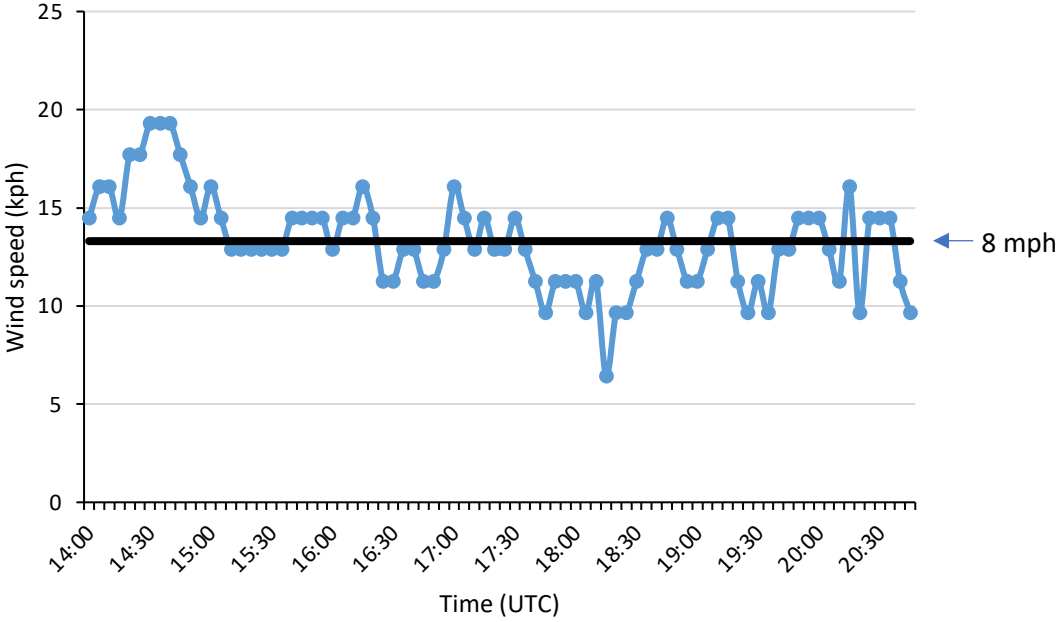
Nozzle	Orifice	D_{v10} (µm)	D_{v50} (µm)	D_{v90} (µm)	% Volume < 100 µm	Droplet Size Classification
CP 09 Straight Stream	0.078	131	355	666	6.2	Medium
CP 09 Straight Stream	0.125	161	374	647	3.5	Coarse
CP 09 Composite Volume Weighted	n/a	148	366	656	4.7	Coarse
ER110	10	189	369	589	1.4	Coarse

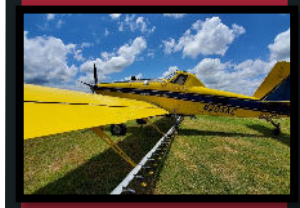


Weather Data









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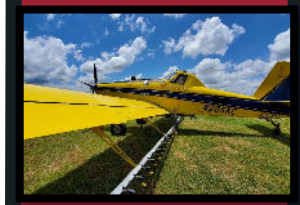

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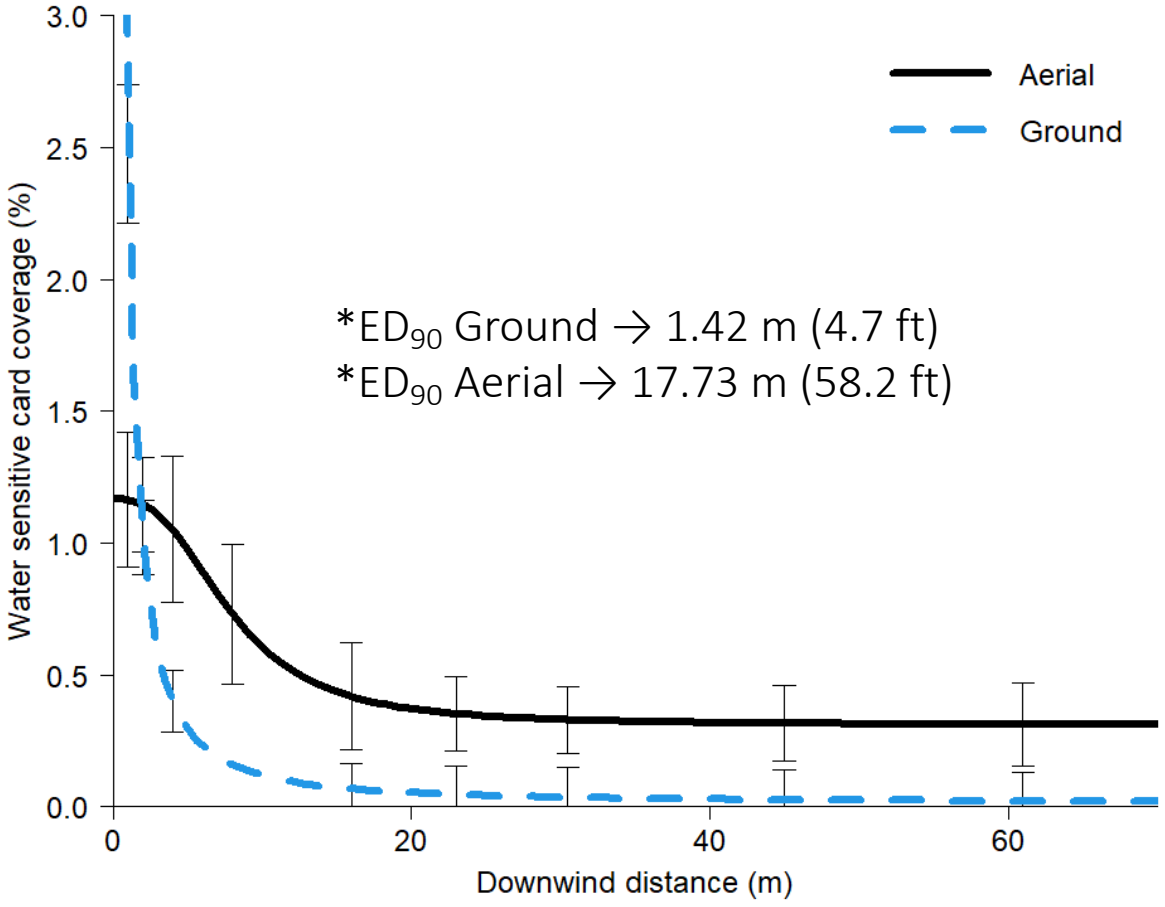
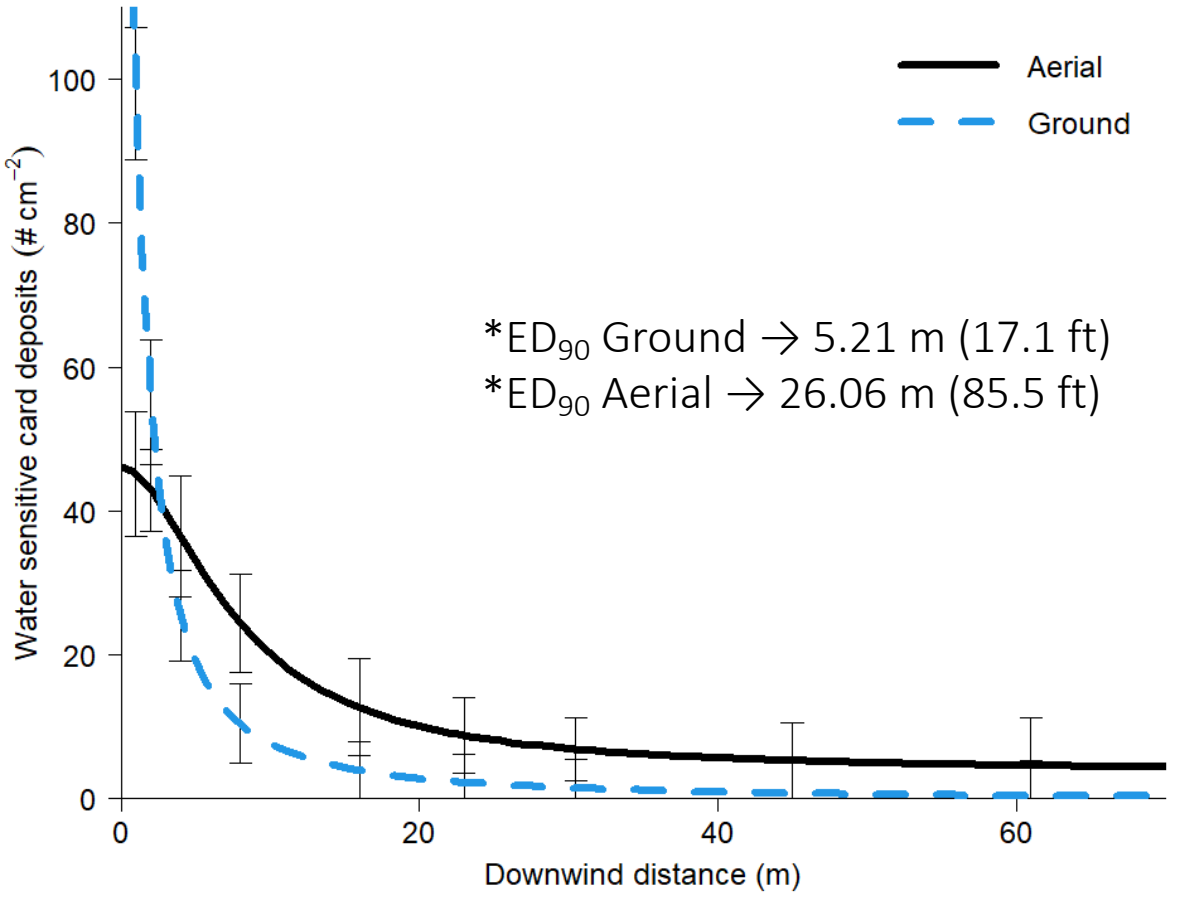
Spray Card Results

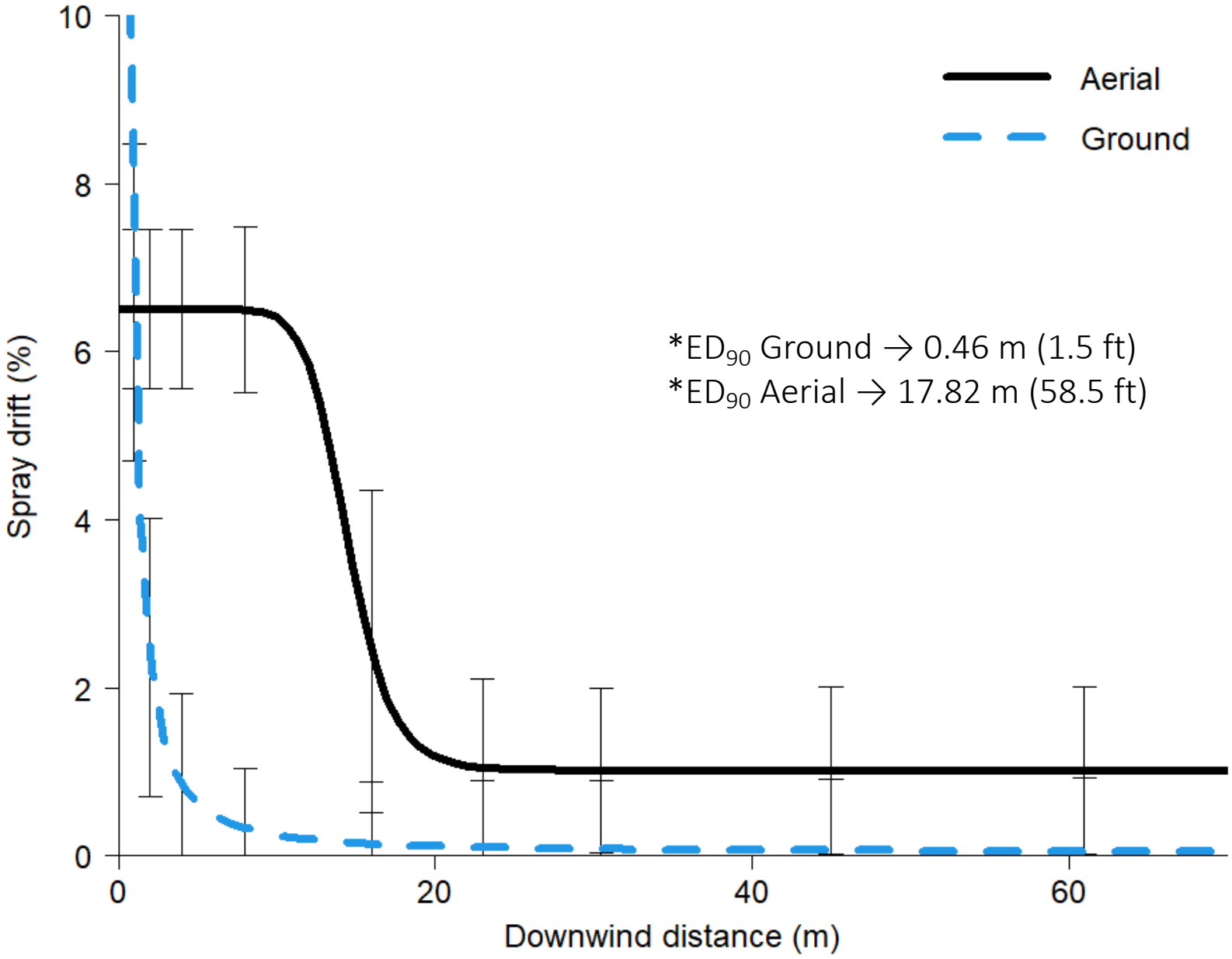




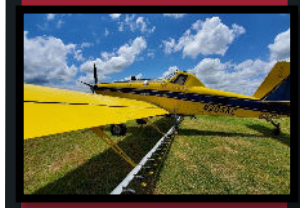
*The aerial application included one full swath width adjustment upwind, i.e. a 70-ft buffer.

Model -> $f(x) = c + \frac{d-c}{1+\exp(b(\log(x)-\log(e)))}$

Mylar Card Results



*ED_{90} Ground → 0.46 m (1.5 ft)
*ED_{90} Aerial → 17.82 m (58.5 ft)



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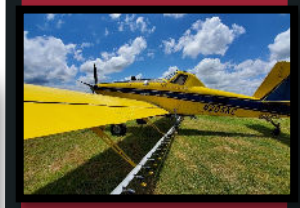
- Pictures taken 3 days after application
- Florpyrauxifen-benzyl (Loyant) injury already evident from both ground and aerial applications
  - Wilting
  - Flipping trifoliates upside down

Ground

Aerial



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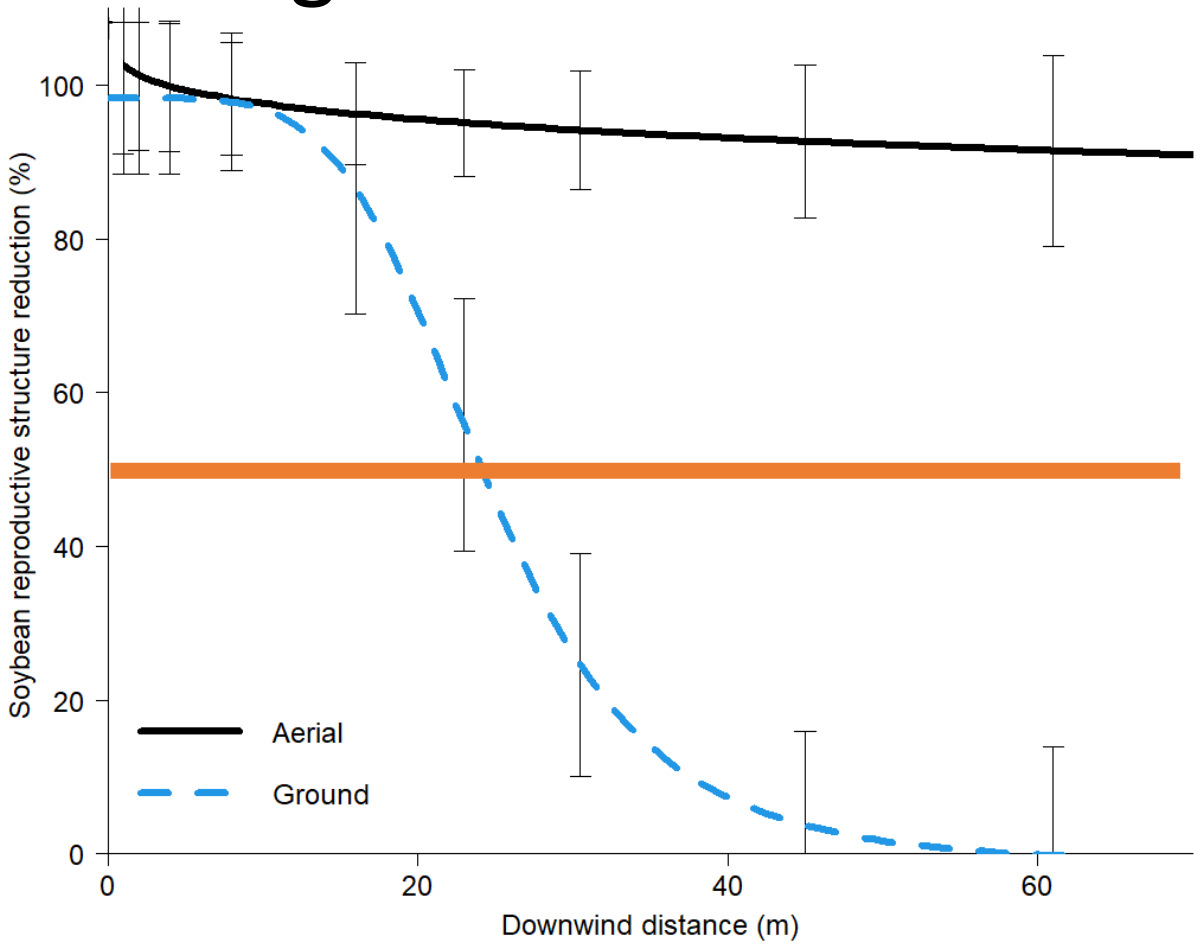
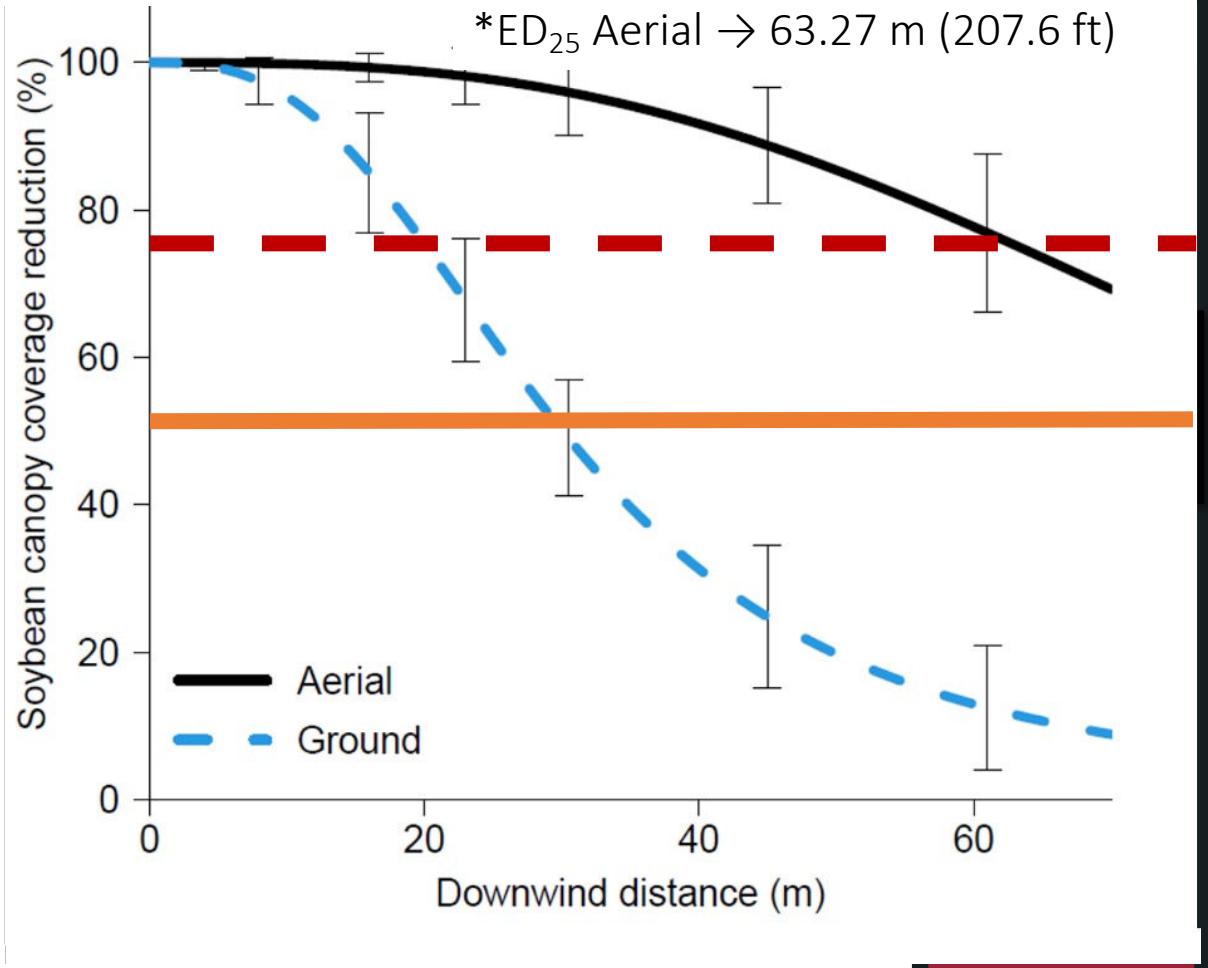
Visual Estimates of Soybean Injury

- Data from 35 days after application

Soybean Reproductive Structures & Canopy Coverage



*ED_{50} Ground → 24.02 m (78.8 ft)
*ED_{50} Aerial → *NA*



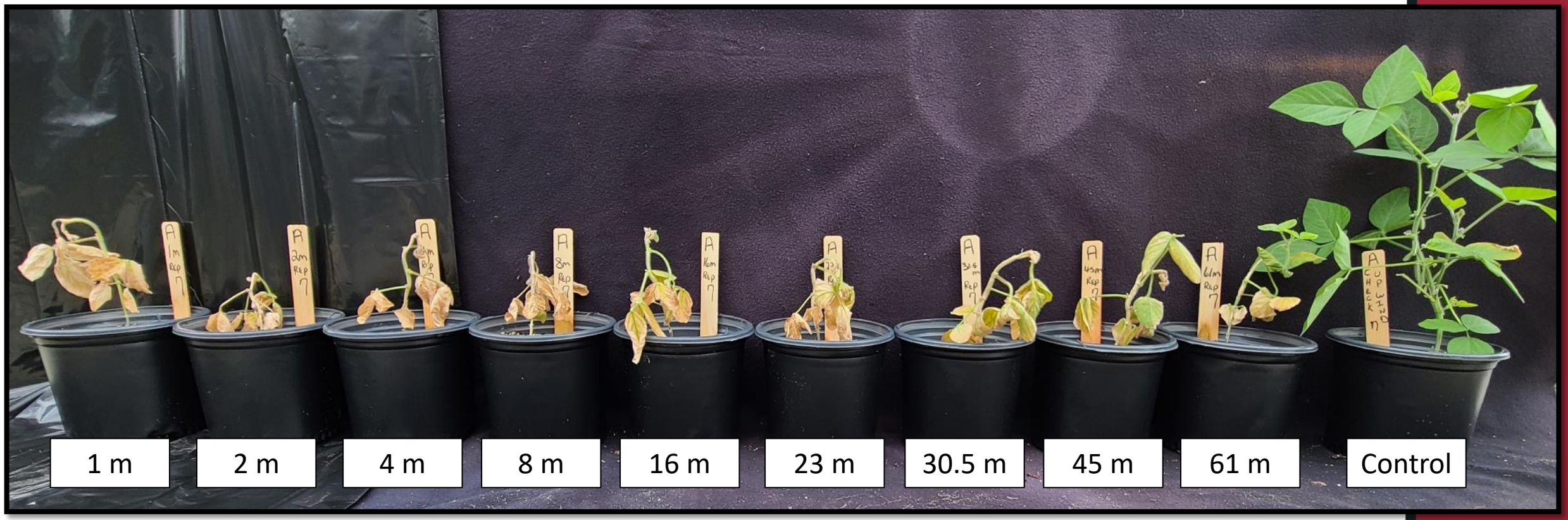
*ED_{25} Ground → 20.19 m (66.2 ft)
*ED_{25} Aerial → 63.27 m (207.6 ft)

*ED_{50} Ground → 30.07 m (98.7 ft)
*ED_{50} Aerial → 93.18 m (305.7 ft)

Data from 35 days after application

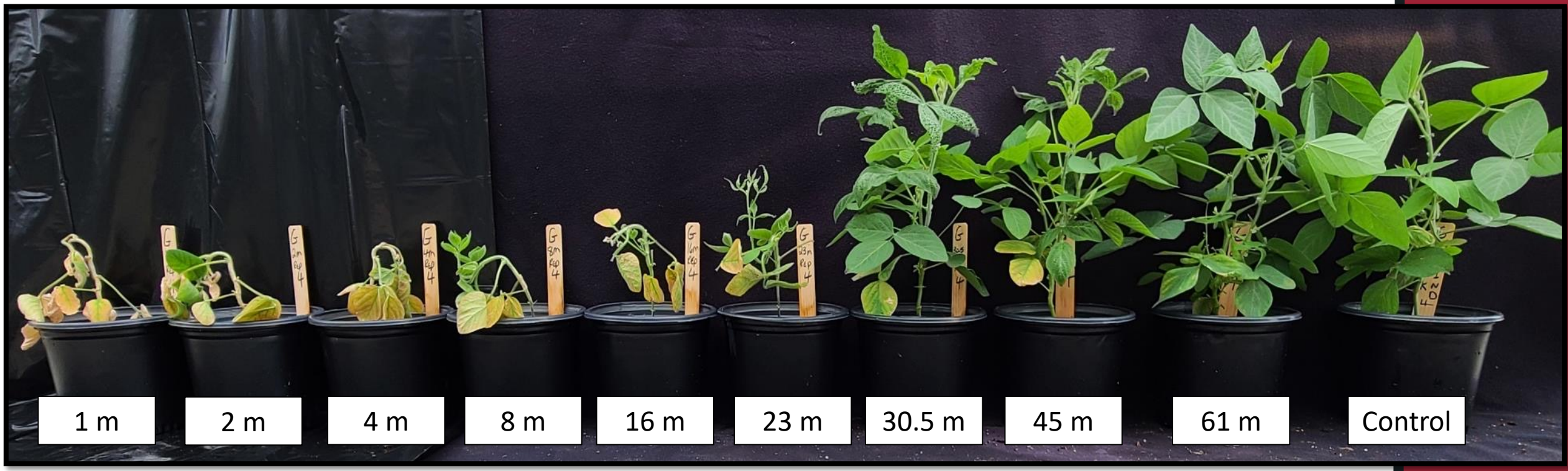
Aerial

- Picture taken 21 days after application



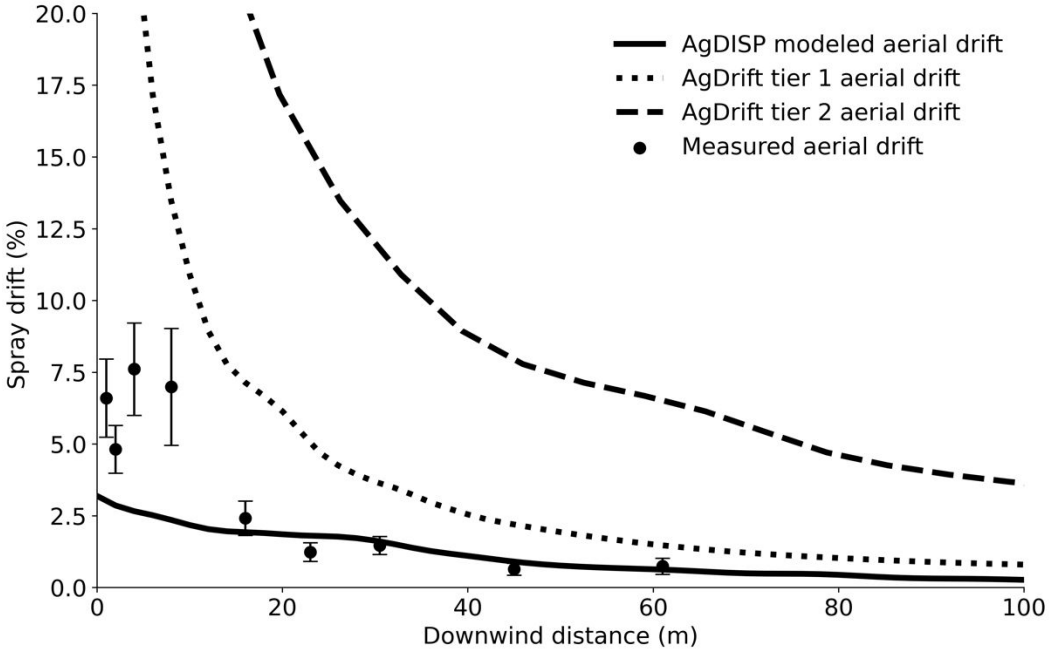
Ground

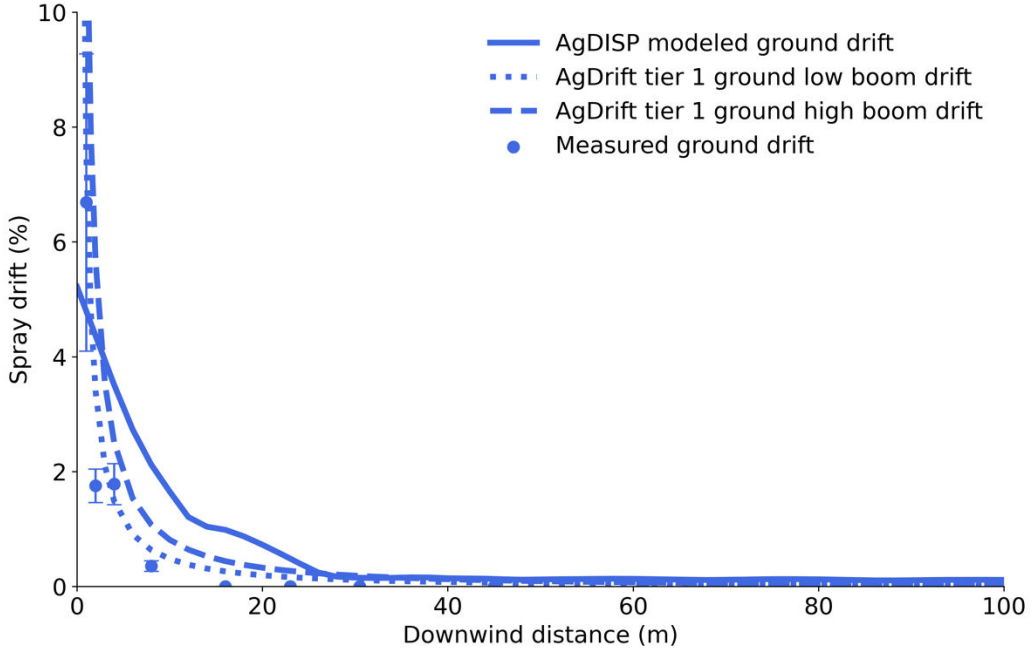
- Picture taken 21 days after application

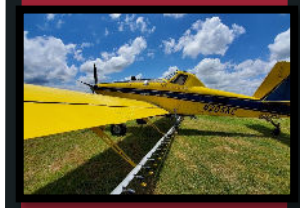


Comparison of AgDISP and AgDrift

- Aerial
  - AgDrift (both tier 1 & 2) overestimated measured drift
  - AgDISP underestimated measured drift in the near field; but matched measured drift in the far field (16-m, 52.5-ft)
  - **AgDISP is a solid and dependable model for assessing aerial spray drift**
- Ground
  - AgDISP and AgDrift tier 1 high boom overestimated measured drift
  - AgDrift tier 1 low boom very closely matches measured drift
  - **AgDrift model more appropriate for ground apps for assessing spray drift**







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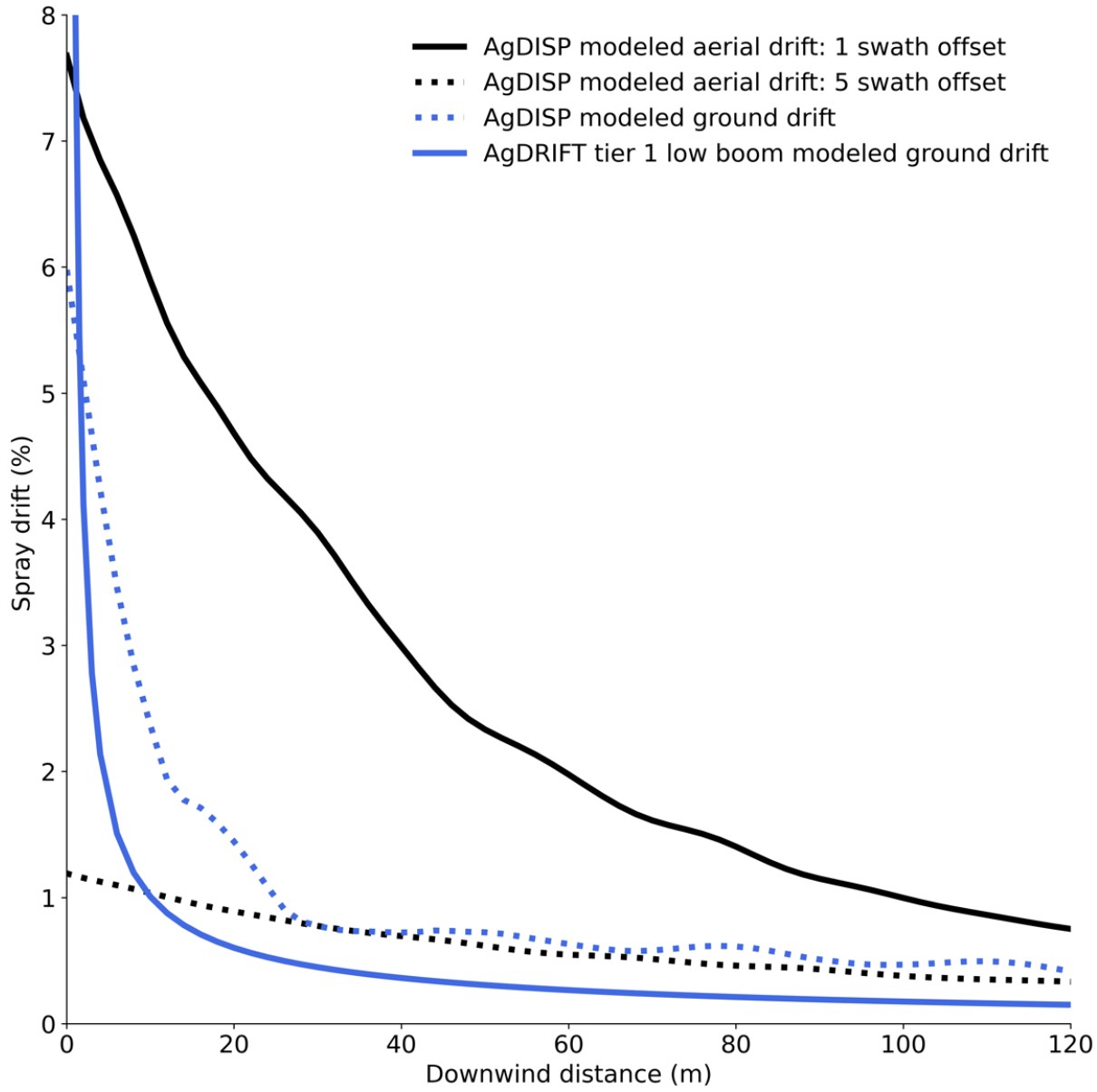
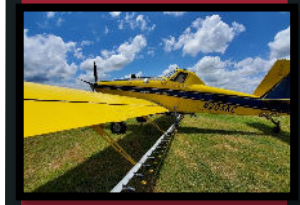
Comparison of AgDISP and AgDrift

(following a simulation of 20 consecutive passes and alternative swath offsets)

- Additional spray passes resulted in 2 to 3 times additional predicted downwind spray drift
- With only 1 swath offset, the aerial application would have 1% spray drift potential reaching ~120-m (~400-ft) downwind
- With 5 swath offsets, spray drift from the aerial application very closely resembles the ground application [1% spray drift potential occurring ~10-m (33-ft) downwind]
- 3 to 5 upwind swath adjustments needed for aerial spray drift potential to be similar to ground spray drift potential





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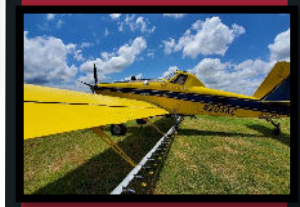
Takeaways

- Generally, the aerial application resulted in **approximately a 3- to 10-fold** greater downwind distance for comparable deposition and soybean injury compared to the ground application. **(Only 1 swath width adjustment)**
- Injury from florpyrauxifen-benzyl (Loyant) spray drift occurs quicker than most other auxin-type herbicides (within 3 days following application) - *Issues? Call a weed scientist!*
- US EPA models fit the collected drift data well; predictions from these models should be reasonable for EPA decision-making.
- Demonstrated the potential influence off-target herbicide movement has on **soybean reproductive structures** (generally, if visual injury present/biomass reduction occurred, a reduction in reproductive structures also occurred).
- Both ground and aerial applications have drift risks; implementing mitigation strategies (swath adjustment, coarser sprays, DRA's, avoidance of poor wind conditions, etc.) is crucial to reduce off-target spray movement potential.
- Aerial applications would likely require a **3-5 upwind swath width adjustment** to exhibit similar downwind drift compared to a ground application.



Takeaways

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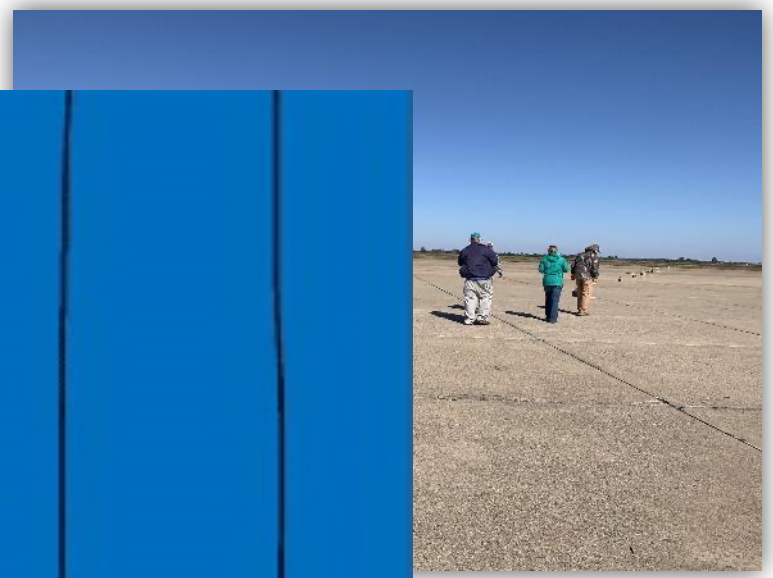

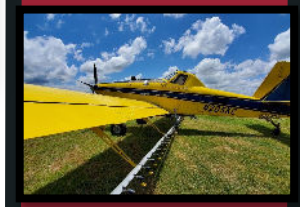

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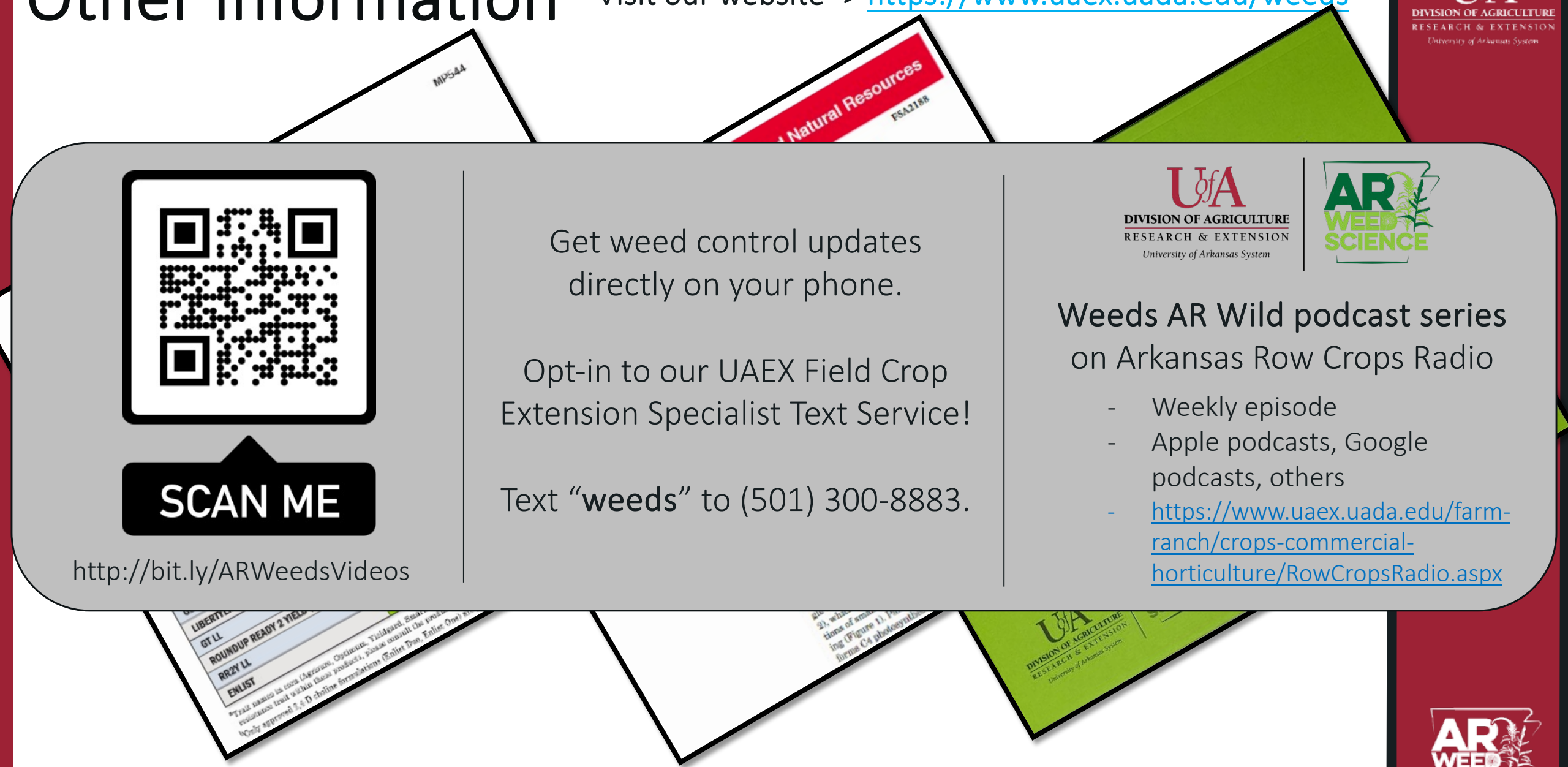

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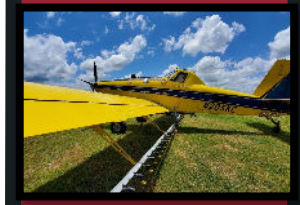
Tri-County Farmers Association, Stuttgart

My weed science crew & other research assistants.



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Please feel free to contact me with any questions.

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