# Herbicide Active, Carrier Volume, and Spray Deposition for Optimizing Drone Herbicide Applications

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## Introduction

- Spray drones, also referred to as Remotely Piloted Aerial Application Systems (RPAAS), have recently gained popularity in the United States as a new application method to apply pesticides.
- Research with traditional application equipment has suggested that increasing carrier volume increases efficacy with contact herbicides, such as glufosinate. Systemic herbicides, such as glyphosate may be applied at lower carrier volumes because any reduction in spray coverage may be counteracted by plant translocation.
- Spray drone applications occur at exceptionally low carrier volumes to maximize efficiency with limited tank size and battery life.

## Hypotheses

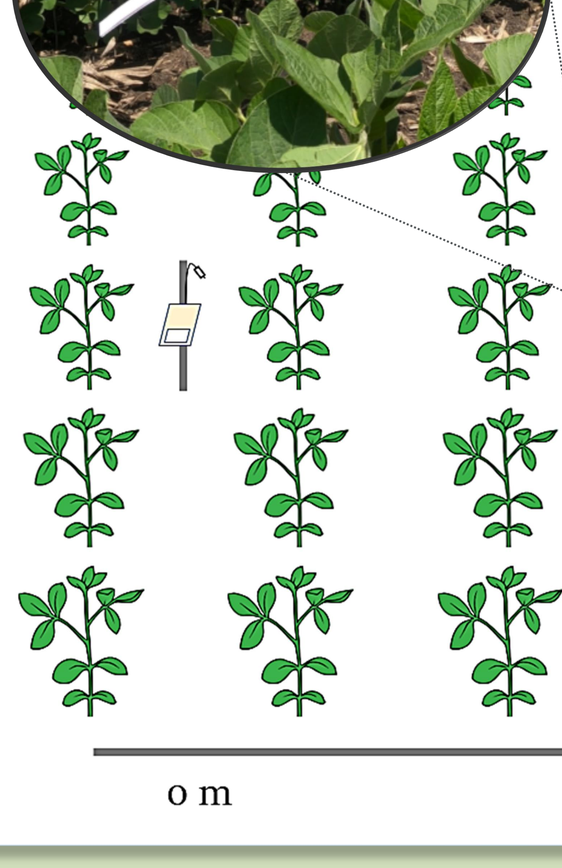
- There will be differences in deposition across the spray swath
- The systemic activity of glyphosate will result in greater efficacy than the non-systemic activity of glufosinate at low carrier volumes

## Objectives

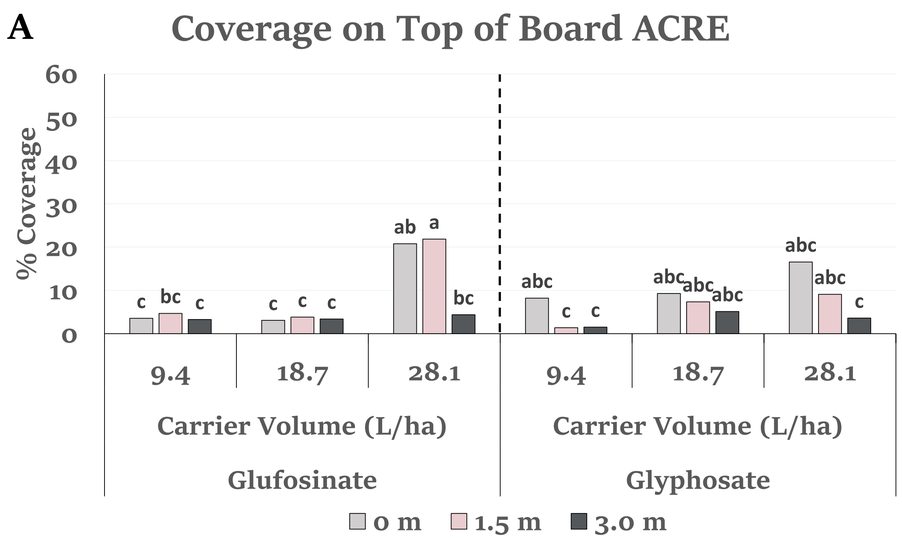
- Quantify the spray deposition and efficacy of glyphosate and glufosinate at different carrier volumes in spray drone applications

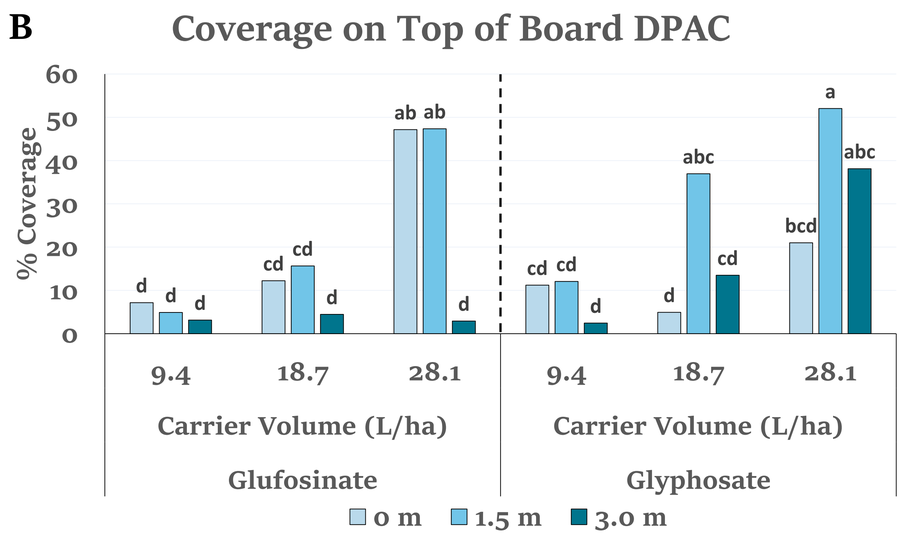
## Materials & Methods

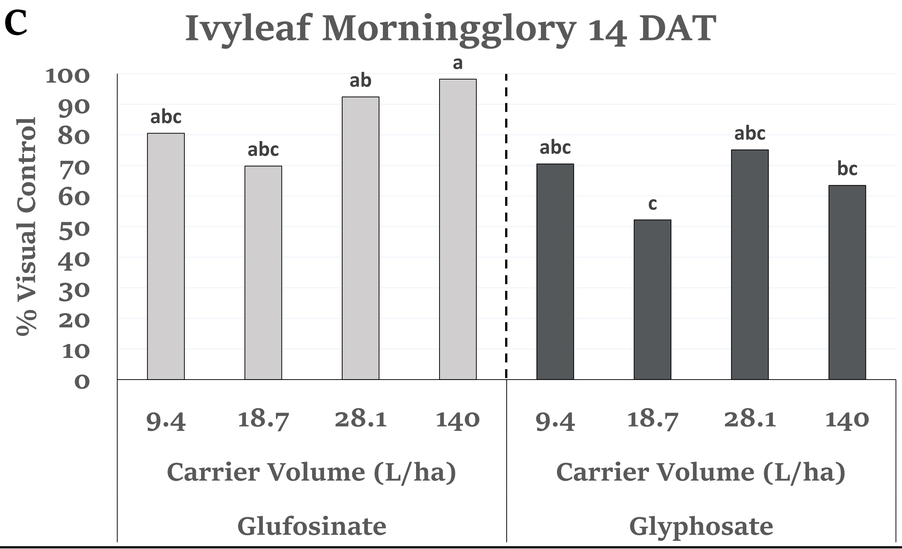
- Factorial of two herbicides and three carrier volumes with four replications
  - Herbicides:
    - 925 g ae $ha^{-1}$ (glyphosate)
    - 717 g ai $ha^{-1}$ (glufosinate)
  - Carrier Volumes:
    - 9.4 L $ha^{-1}$
    - 18.7 L $ha^{-1}$
    - 28.1 L $ha^{-1}$
    - 140 L $ha^{-1}$ (hand boom)
- Spray solution contained pink foam marker dye (0.25% v/v) to visualize spray deposits on Kromekote cards located at 0, 1.5, and 3.0 m from the center of the spray drone towards the outside of the spray swath (See Figure Below).
- Four weed targets of uniform size per plot were marked for data collection on herbicide efficacy
- Drone Parameters:
  - DJI Agras T30 equipped with 12 TeeJet XR11001 nozzles
  - Assumed swath: 9 m
  - Height above vegetation: 3 m
  - Speeds:
    - 9.4 L $ha^{-1}$ = 24 km $hr^{-1}$
    - 18.7 L $ha^{-1}$ = 16 km $hr^{-1}$
    - 28.1 L $ha^{-1}$ = 10.7 km $hr^{-1}$
- ACRE: XtendFlex soybeans were planted at 346,000 seeds $ha^{-1}$ in 76 cm rows
  - Herbicide treatments were applied 07/07/2023
    - Air Temperature: 24°C
    - Relative Humidity: 55%
    - Wind Velocity: 0-4.8 km $hr^{-1}$
- DPAC: Enlist soybeans were planted at 376,000 seeds $ha^{-1}$ in 38 cm rows
  - Herbicide treatments were applied 07/10/2023
    - Air Temperature: 31°C
    - Relative Humidity: 48%
    - Wind Velocity: 1.6-6.4 km $hr^{-1}$
- Data were analyzed in R with ANOVA. Means separated using Tukey's HSD ($P<0.05$)




## Results



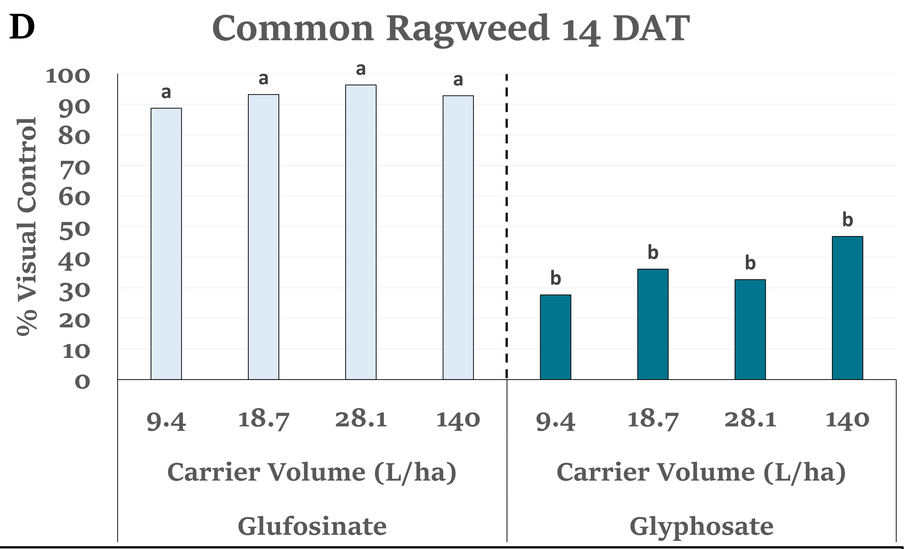




**Figure 1: Panels A-D describe spray coverage and weed control at ACRE and DPAC. Means were separated across carrier volume and herbicide using Tukey's HSD ($P<0.05$)**
**(A)** Spray coverage of glufosinate and glyphosate on top of board at ACRE. **(B)** Spray coverage of glufosinate and glyphosate on top of board at DPAC. **(C)** Efficacy of glufosinate and glyphosate on ivyleaf morningglory (IPOHE) 14 DAT at ACRE. **(D)** Efficacy of glufosinate and glyphosate on common ragweed (AMBEL) 14 DAT at DPAC.

## Results Continued

- Overall, spray coverage was greater at DPAC than at ACRE, which was likely associated with the lower air temperatures and higher relative humidity at the time of application at DPAC.
- Spray coverage decreased towards the outside of the spray swath at ACRE (Figure 1A), while the greatest coverage at DPAC occurred at 1.5 m from the center of the drone (Figure 1B).
- As expected, increasing the carrier volume increased spray coverage at all collection points along the spray swath and was also associated with an increase in control of ivyleaf morningglory (*Ipomoea hederacea* Jacq.) (Figure 1C).
- Weed control was greater with glufosinate across all carrier volumes at each site compared to glyphosate. Glufosinate also resulted in greater efficacy on common ragweed (*Ambrosia artemisiifolia* L.) than glyphosate, but no differences in efficacy were observed across carrier volumes within each herbicide (Figure 1D).
- Contrary to our hypothesis, the low carrier volumes used with a spray drone resulted in greater efficacy with the non-systemic herbicide glufosinate versus glyphosate.

## Future Research

- Research trials will be conducted in 2024 to further investigate spray coverage and quantify herbicide deposition along the spray swath and the relationship with the uniformity of weed control with spray drone applications.

## Acknowledgements

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