Spray Deposition and Efficiency of Fungicide Applications in Corn with a Spray Drone

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Introduction

- The application of pesticides using unmanned aerial application systems (aka spray drones) is gaining interest rapidly in the United States.
- Timely application of fungicides is critical to protect corn yield from diseases such as southern corn rust and northern corn leaf blight (Paul et al., 2011).
- Fungicide applications in corn are among the top uses of spray drones currently in the Midwest and Southeast United States.
- Understanding the effect of different parameters on spray deposition and efficiency of fungicides applied with spray drones is important to inform best management practices and for effective technology utilization among growers and drone applicators.

Hypothesis

Application parameters such as spray volume and height will significantly influence spray deposition and efficacy of fungicides applied with a spray drone.

Objective

To assess spray deposition and efficacy of fungicide applications in corn with a spray drone at different spray volumes and heights from the crop canopy.

Methods

Spray Drone System:

- DJI Agras T30 agricultural spray drone *(30L tank, 16 nozzle configuration, Hexacopter)*
- DJI D-RTK 2 high-precision GNSS mobile base station

Study Treatments:

- Two target spray volumes: *18.7 and 46.8 L ha^{-1}*
- Four heights to target different spray swaths: *1.5, 2.3, 3.0 and 3.8 m*

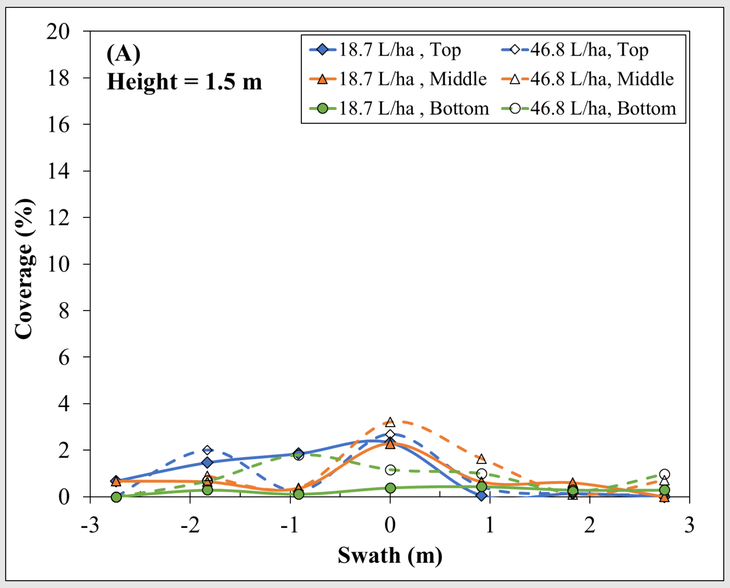
Data Collection:

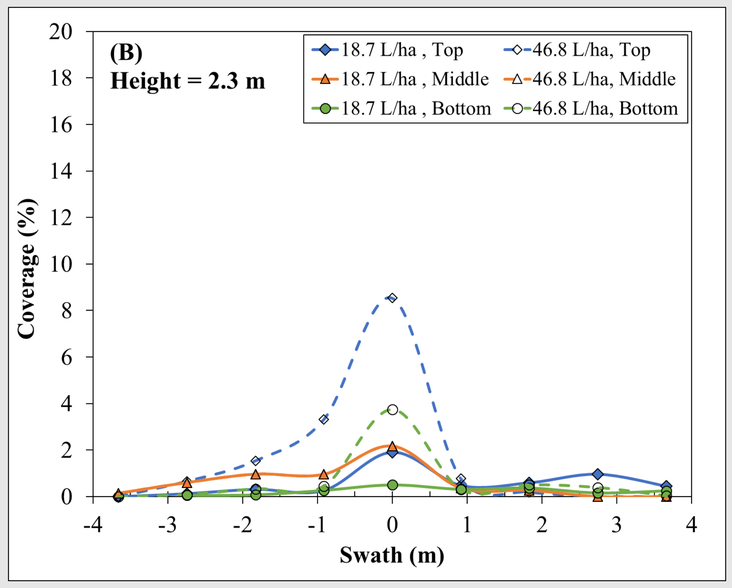
- Spray deposition was assessed using water-sensitive paper (WSP) placed at three different positions within the canopy: top (2 leaves above the ear leaf), middle (ear leaf), and bottom (2 leaves below the ear leaf).
- Spray deposition was measured using water only as a spray solution and across the whole spray swath for each treatment. To assess efficacy, fungicide products were applied in plots that measured 7.3 m (8 rows) × 24.3 m.
- Each treatment was replicated three times and randomized within the field. An untreated check was also left in the field to aid with disease ratings.
- Disease ratings were collected at three weeks after application to assess southern corn rust (SCR), tar spot (TS) and northern leaf blight (NLB). Yield was collected by harvesting center four rows (3.7 m) in each plot.

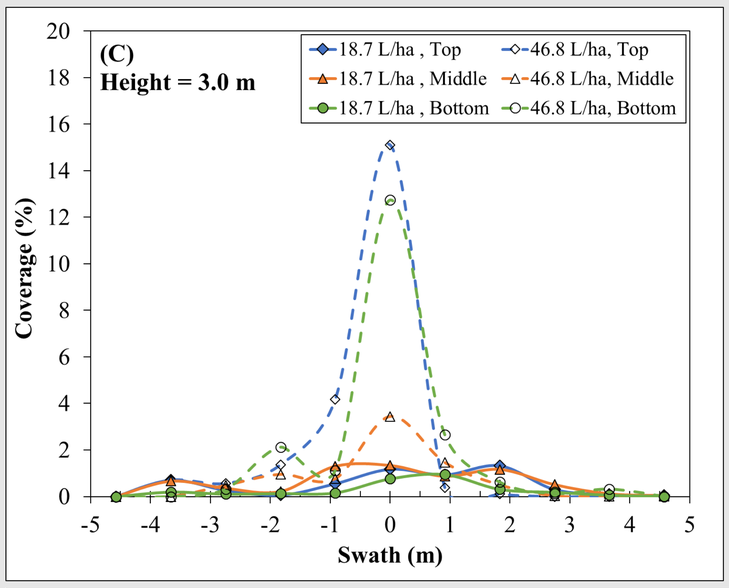
Data Analysis:

- WSP was analyzed using a DropScope instrument (SprayX, São Paulo, Brazil), which provided the area covered by spray droplets as coverage (%).
- Mean coverage was computed from replicated data and plotted to analyze trends across the swath.
- Data was subjected to an analysis of variance (ANOVA) and means were separated using the Student's t-test (α=*0.05*) in JMP Pro 16.0.

Results







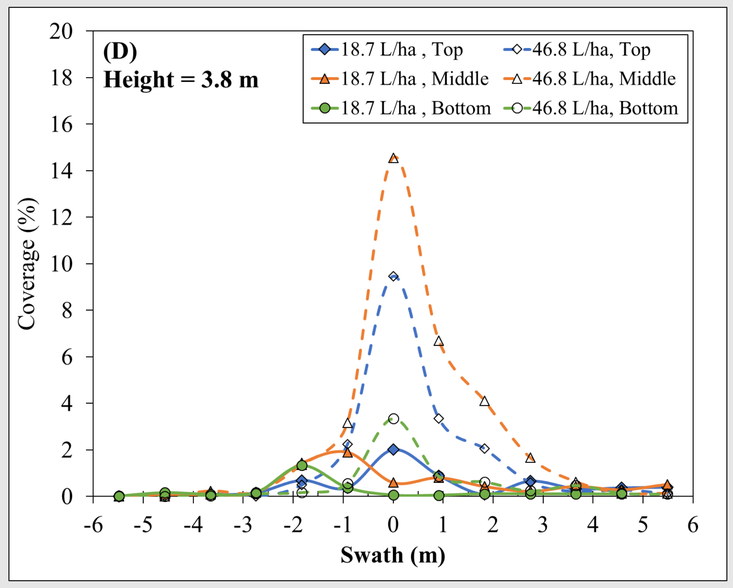


Figure 1: Spray coverage (%) at the top, middle and bottom positions within the corn canopy across the swath. Each graph represents spray deposition at different canopy positions for two spray volumes (18.7 and 46.8 L ha^{-1}) grouped by height (1.5, 2.3, 3.0 and 3.8 m).

Table 1: P-values from the ANOVA test illustrating the effect of spray volume, height, and their interaction on spray deposition at different canopy positions. * indicates significant effects at $p \leq 0.05$.

Effects	Top	Middle	Bottom
Spray Volume	0.0327*	0.0243*	0.0016*
Height	0.9136	0.2197	0.0970
Volume × Height	0.5929	0.1199	0.1435

Table 2: Disease severity ratings and corn yield for spray volume treatments and untreated control. Values with the same letter within a column are not significantly different from each other ($p > 0.05$).

Treatment	TS (%)	NLB (%)	SCR (%)	Yield (kg ha^{-1})
18.7 L ha^{-1}	0.0685	1.97 b	0.0351 b	13,585
46.8 L ha^{-1}	0.0000	0.03 b	0.0067 b	12,711
Control	0.0074	6.70 a	0.4345 a	12,482

Conclusions

- Spray volume had a significant effect on spray deposition across all three canopy positions while application height showed no influence on deposition at any position within the canopy.
- The higher spray volume of 46.8 L ha^{-1} showed consistently higher coverage especially towards the center of the swath than the lower rate of 18.7 L ha^{-1}.
- Spray deposition was greatest at the top of the canopy and reduced thereafter towards the middle and bottom positions in the corn canopy.
- Both spray volumes exhibited similar efficacy on southern corn rust and northern leaf blight. No significant difference was observed for tar spot and corn yield between the study treatments and untreated control.

Future Research

To evaluate and compare the spray deposition and efficacy of fungicides applied with a manned aerial applicator (crop-duster) and spray drones in corn.

References

Paul, P. A., Madden, L. V., Bradley,……. Esker, P. (2011). Meta-Analysis of Yield Response of Hybrid Field Corn to Foliar Fungicides in the U.S. Corn Belt. *Phytopathology®*, *101*(9), 1122–1132.

Acknowledgements

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