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Introduction

 The application of herbicides to field crops requires machines to be consistent and efficient.

 Unmanned Aerial Vehicles (UAVs) show promise as a potential new method of herbicide application.

 Few studies have been conducted to determine effects of different UAV application parameters on spray quality and weed control.

Objectives

- 1. Evaluate weed control, spray coverage and uniformity, and offtarget movement following herbicide applications from a DJI Agras T40 compared to a ground-based sprayer.
- 2. Determine the effects of application speed, height above the soybean canopy, and application rate on spray coverage with the DJI Agras T40.

UAV vs. Ground-based Sprayers Experiment Materials and Methods

- DJI Agras T40
- 3 Gallons per Acre (GPA)
- Extra Coarse nozzle setting
- 16 mph
- 10 ft application height
- 33.37 ft swath



- Case IH 3340
- 15 Gallons per Acre (GPA)
- MR110-10 Combo jet nozzles
- 10 mph
- 3 ft application height
- 100 ft swath



- John Deere 4830
- 20 Gallons per Acre (GPA)
- Turbo TeeJet 11005 nozzles
- 12 mph
- 3 ft application height
- 100 ft swath



UAV vs. Ground-based Sprayer Experiment Materials and Methods

- Individual plots 100' x 240'; treatments replicated 3 times
- 32 oz Enlist+ 20 oz Roundup + 2.5 oz Anthem maxx / a applied via both machines
- Water sensitive spray cards placed at the top of the soybean canopy
- Visual weed control recorded at the location of each spray card within each plot
- ImageJ software used to determine percent coverage, droplet size and number
- Data analyzed in SAS using PROC GLIMMIX. Means separated with Fisher's Protected LSD at P<0.05 level of significance.





Spray Coverage and Uniformity Following Application with the DJI Agras T40 UAV vs. Ground-based Sprayers



*Means within a category followed by the same uppercase or lowercase letters are not different, LSD=0.05.

Representative Spray Card Coverage Along the Swath Width



Average Droplet Size Along the Sprayer Swath Following Application with the DJI Agras T40 UAV vs. Ground-based Sprayers



*Means within a category followed by the same uppercase or lowercase letters are not different, LSD=0.05.

DJI Agras T40 Centrifugal Atomization Wilger MR110-10 Nozzles



Case IH 3340 **Combo-Jet**



John Deere 4830 **Turbo Teejet** 11005



286 µ (Medium) **1640 Droplets**

457 μ (Very Coarse) 778 Droplets

480 µ (Very Coarse) **835 Droplets**

Weed Control

Waterhemp control ranged from 68 to 75% and there was no difference in weed control between the ground-based spray application and the DJI Agras T40 application.



UAV vs. Ground Sprayer Experiment: Conclusions

- The ground-based sprayer demonstrated superior spray coverage, uniformity, and less off-target movement than the DJI Agras T40 UAV.
- There were no differences in weed control between the two machines when applying Enlist+Glyphosate+Anthem Maxx.
- The "Extra Coarse" nozzle setting on the DJI Agras T40 does not produce coarse or extra coarse droplets according to ASABE standards.





UAV Application Parameters Experiment: Materials and Methods

- Individual plots 25' x 200' long
- 42 oz Liberty + 1 lb/gal AMS / a + 1.5% v/v Vision Pink foam dye sprayed on V5, 1 foot soybeans
- 8.5 x 11 in Kromekote cardstock placed 10 ft apart along the swath in 2 rows spaced 66 ft apart (6 cards in each plot)
- Visual weed control recorded at the location of each spray card in each plot



UAV Application Parameters Experiment: Materials and Methods

- UAV spray treatments:
 - 1) 3 GPA,10 ft height, 13 ft/s
 - 2) 3 GPA, 10 ft height, 26 ft/s
 - 3) 3 GPA, 15 ft height, 13 ft/s
 - 4) 3 GPA, 15 ft height, 26 ft/s
 - 5) 6 GPA, 10 ft height, 13 ft/s
 - 6) 6 GPA, 10 ft height, 26 ft/s
 - 7) 6 GPA, 15 ft height, 13 ft/s
 - 8) 6 GPA, 15 ft height, 26 ft/s
- Treatments arranged in a RCB design with 3 replications
- Spray coverage and weed control data analyzed as described previously

Influence of UAV Application Parameters on Waterhemp Control



*Bars followed by the same letter are not different, LSD=0.05.

Influence of UAV Application Parameters on Spray Coverage



*Bars followed by the same letter are not different, LSD=0.05.

Investigating Spray Volume, Speed, and Application Height with a UAV What will all this mean for weed control?



Treatment : 42 ozs Liberty + 3 lbs AMS + 4 ozs Interlock

UAV Application Parameters Experiment: Conclusions

- Increasing spray volume to 6 GPA and lowering the altitude to 10 ft improved coverage and weed control.
- Application speed had no effect on coverage or weed control.



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SPRAY





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