# A View from Above: Using Images from Drones to Identify Insects


Megan Workman[1,2] and Dr. Brian McCornack[1]

[1]Department of Entomology, College of Agriculture, Kansas State University
[2]Department of Agronomy, College of Agriculture, Kansas State University



## Abstract

The use of unmanned aircraft systems, or UAS (a.k.a. drones), in Agriculture has increased with improvements in technology. Using UAS to scout fields can decrease the amount of time spent per field, allowing more ground to be covered in a day. When using a UAS to scout for insects it is important for the data to be clear enough to make correct identification of any insect present. Changes in the altitude of the flight affect the image quality, affecting the ability to identify. With this experiment we hoped to find which altitudes allowed for correct identification of known insects. The results showed that images taken from an altitude above 4 meters will result in less than 40% correct identification. Pinpointing a key altitude for insect scouting will allow for more correct identification of insects when using UAS systems.


## Purpose

The purpose of this research is to distinguish a key altitude that allows for correct insect identification when using UAS systems for scouting.

## Questions, Hypotheses, and Predictions

Question: How much does sensor altitude affect our ability to identify insects on the ground?

Hypothesis: Altitude affects the percent of correct insect identifications

Prediction: As the altitude of the sensor increases, the number of correct identifications will decrease

## Study System

Figure 1. Small UAS (DJI Mavic Pro) equipped with an CMOS sensor.

For this experiment we used a DJI Mavic Pro. This UAS comes with a 12.35-megapixel, 1.35 cm, CMOS (complementary metal oxide semiconductor) sensor that has a stabilized gimbal [3]. The Mavic Pro system was chosen because it is portable, durable, low cost, and easy to access.

We chose insects that varied in size, color (shade and pattern), shape and included: earwig, Dectes stem borer, western corn rootworm, spotted cucumber beetle, Japanese beetle, cicada, convergent lady beetle, green stink bug, and bean leaf beetle [1 & 2].

Figure 2. The insect arrangement

## Methods and Experimental Design

For this experiment, we randomly arranged our study insects in a 3 x 3 grid on a solid green background consisting of construction paper. Using the DJI Mavic Pro we flew above the insect board and acquired images in JPEG format at sensor altitudes of 0.3, 0.8, 1.0, 2.0 m, 4.0, 8.0, and 16 m. We then created 9 equally sized panels (1 panel per insect per image) using ImageSplitter by Postcron at each altitude for a total of 63 images (Fig. 4). We then randomized the order of the individual panels to prevent bias in identifications. To test the effect of altitude on images used for insect identification, we asked students (n = 22) to review and determine insect species for each panel using a lettered key that consisted of high-resolution images of our target insects. Number of correct identifications was calculated as a percentage and a best fit line was used to determine the relationship between sensor altitude and percent of insects correctly identified.

Figure 3. Placing the insect arrangement

Figure 4. Image taken at 16 m altitude

## Results

There was a negative relationship between sensor altitude and a student's ability to correctly identify insects. As sensor altitude increased, the percentage of correct identifications decreased. For all species tested, all sensor altitudes above 4 m resulted in less than 40% correct identifications.

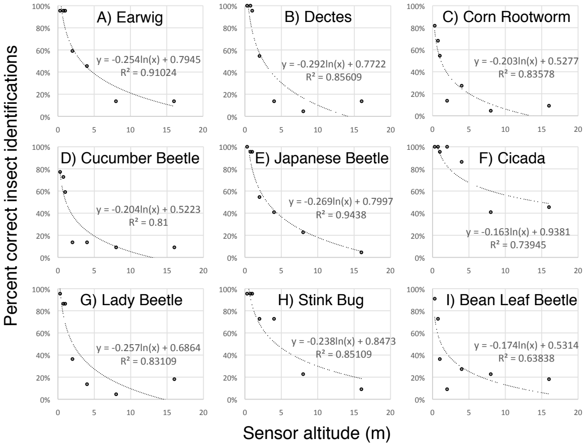


Figure 5. Relationship between altitude and correct identification of different insect species.

## Conclusions

Correctly identifying insects using a small UAS is limited by sensor altitude or distance from the targeted species. In our study, students could correctly identify known targets using images collected from a Mavic Pro, but sensor altitude should not exceed 4 m. Setting a maximum altitude allows for less troubleshooting while in the field, which saves time, and provides more consistent data. Our study system was effective because not all the insects were identified correctly at both high and low altitudes. Some insects were correctly identified at higher altitudes, but this was likely caused by guessing from the students (Fig. 6).

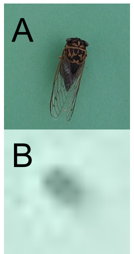


Figure 6. Cicada at altitudes of (A) 0.33 m and (B) 16 m.

## Future Directions

If I were to continue this research, I would like to gather more data. I would do this by finding more participants to take the quiz created. To help minimize the effect of a quiz taker guessing, I think it would be helpful to add a "cannot identify" option to the quiz. To continue the data past what we completed, there are several questions to investigate. One question would be: does the coloration or pattern of the insect affect the ability to correctly identify it at a given altitude? This could be tested by setting an altitude and background color and testing if different insect colorations or patterns affect the identification. Another question to ask would be: does the background color or pattern (crop type or foliage arrangement) affect insect identification? This question would investigate the many colors of the canopy during the growing season (brown, green, etc.) and see if the different colors affect the identification of a given insect. I found a study that investigated the use of UASs when surveying wildlife to reduce the disturbance to the animals [4]. Relating this study to crops, I think looking into the differences in crop injury when scouting in person vs. a UAS could be interesting. Another factor to consider going forward is moving targets; what changes are made to the scouting and identification when the insects are alive?


## References

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