Efficiency of Crop Spraying Drone

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In our day and age, we face many problems such as global climate change, we must utilize new technology to combat this problem such as crop spraying drones. The main reason is to help us with our sustainability problem, because it is battery powered (not fuel), more precise (less environmental drift), and less workplace accidents/hazards. Even with all these benefits farmers are not drawn to this new technology due to it having a low return on investment. Our hypothesis is that even though drones are not deemed efficient now, soon drones will be more efficient than the current crop spraying techniques. We had three tests: set up, java efficiency algorithm, and droplet analysis. However, when conducting tests, we realized drones are very time consuming and how the cost outweighs the benefits. WE learned that there are a lot of variables that go into drone cost benefit analysis, but the main costs were setup, battery technology, and refill time. constant refilling, pesticide waste, and time. Given this information we conclude that for things to work we need to think greatly outside the box for new innovative solutions.

There are many types of sprayers, hand sprayer, crop duster, tractor, and drone. According to The Newest Technology for Precision Agriculture by Nikki J. Stehr "There are estimates that 80 to 90% of the growth in the drone market in the next decade will come from agriculture" Even though there is a predicted market for drones in agriculture, farmers lean towards more traditional crop spraying techniques instead. When doing research, I found the following chart that shows a comparison of taking images with a plane, satellite, and drone under a certain acreage is more efficient. Given this I would not rule out drones and my hypothesis is that drones are more efficient when certain conditions are met and what the drone is used for.

Our method included: Performed research to define the variables that encompass the efficiency of crop spraying and created a Cost-Benefit Analysis. Fly the DJI Agras T16 Spray Drone to perform droplet dispersion analysis. Gathered pertinent data to make a realistic scenario for an efficient crop spraying operation that would provide a farmer some return on investment. Using our variables, created algorithms that calculated the costs for drone and traditional spraying operations.

To ensure accuracy we created real life scenarios: Farmer has no technical knowledge and would like to receive training so they can fly the drone (DJI Agras) themselves. Plant organic fresh market tomatoes. Use Fungicides and/or Bactericides (biofungicides) Double Nickel and Insecticide and Miticides (bioinsecticides) PFR-97 20% WDG. Location: Merced California. 1-35 acre scenario. The farmer wants to keep environment and worker hazards to a minimum. To get the maximum use out of the drone the farmer would also like to know other ways the drone serves use besides crop spraying techniques.

In the scenario we assumed the farmer had no technical knowledge, with no previous experience setting up and flying the drone we recreated that part of the scenario. We found some problems the farmer might face before they even get off the ground. The directions we received were in Chinese (we needed to look up English ones online), firmware took hours to update, and set up was very confusing (took a lot of online research). During the flight the downsides were short battery life (10 minutes), calibration of sprayers took a whole tank (wasted pesticides), and the tank needed to be refilled often (10 L tank).

Originally in our hypothesis we assumed that crop spraying planes had an advantage due to their speed and how well it can handle wind. From research we found the wind conditions must be ⅔ or less the max speed, obviously giving the crop duster (130 mph) an advantage over the drone (8 m/s). However, when conducting the drop analysis of the drone we found the slower the drone the more pesticide that gets onto the crop. Given this data slower = precise, the drones slower speed might give an advantage.

In the future I would like to conduct a test of both the crop spraying drone vs. plane in real life. I would take a field of low acres under 20 and field of higher anchorage over 20, then conduct the same test (droplet, cost, and time) to see which, one is more precise and cost efficient. One thing to note is the rise in research involving the future of electric aircraft which may affect the need for AG drones.

In conclusion drones such as the DJI Agras still have a long way to go if they want to compete with the current crop spraying methods. The short battery life, tank refill/amount can carry, and set up must be fixed for it to be more competitive. Due to low returns on investment, I do not foresee the farmer having the time and patience to utilize drone technology, but with future improvements and drone ag business start-ups efficient drone use can be accomplished and return on investments made.

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