How UAS are affecting agricultural practices

Joshua Bandt

Aviation Education, South Dakota State University

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Instructor Ric Stephens

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Abstract

The field of aviation and agriculture are both constantly evolving and changing areas. As agricultural advancements are made so too are unmanned aircraft systems, we are starting to see a symbiotic relationship being formed between the grower and operator. If the grower can obtain aPart 107 certificate, they can also help to better their own neighbors' operations using modern-day technologies. These modern-day technologies help the grower to identify areas of the crop that would not yield to their full potential if the unmanned aircraft system were unable to identify areas of malnourishment or drought. Throughout this paper, we will discuss the new applications growers are using unmanned aircraft systems.

Keywords: Aviation, UAS/Unmanned aircraft systems, and agriculture.

How UAS are affecting agricultural practices

Every farmer's dream is to know exactly what their plants need to produce the maximum yield in a growing year or season. Thanks to our advancements in unmanned aircraft systems, this is no longer an extreme cost to the average person, but a much more affordable solution that more agricultural operations are beginning to utilize. There are a few ways in which the usage of unmanned aircraft systems can be implemented to optimize your growing season, including plant stress detection, field mapping, weed management, biomass, andfield nutrient estimation, and much more.

A primary means to detect if your crop will not be able to have maximum yield is through plant stress detection, Hassler goes on to discuss how "Detection of various plant stresses is a widely used application of UAS in agriculture. The most common forms of stress being detected via UAS include water stress, nutrient stress, and plant diseases. Water stress can be fairly simple to detect and is generally detected through a combination of NDVI and crop water stress index (CWSI) values, the latter of which is generated using thermal imaging." How do they do this? Some manufacturers are beginning to team up with brands such as DJI to produce drones with special agricultural designed unmanned aircraft systems with special sensors and cameras built into the already tried and true aircraft of the DJI brand. Turning this photographer's dream into a grower's dream.

Another aspect that is very appealing to the agricultural community is the need or overuse of nitrogen on cash crops such as field corn. Nitrogen is an essential part of the growing process and can help to maximize profits through a higher yield if the application is correctly done. Currently, the unmanned aircraft systems are according to Zaman-Allah "showed how NDVI datafrom a multi-spectral camera aboard a UAS can be used to phenotype low-nitrogen stress

tolerance in maize. Other more specific vegetation indices have been developed for more accurate detection of nitrogen deficiency remotely, such as the nitrogen nutrition index (NNI), which can be calculated using the modified chlorophyll absorption ratio index (MCARI) and modified triangular vegetation index 2 (MTVI2) obtained through hyperspectral imaging." As we near a realistic and cost-effective unmanned aircraft system that can accurately detect nutrition deficiencies such as nitrogen or other, we look now into how biomass plays a role in the modern-day agricultural landscape.

Biomass and field nutrient estimation is one of the most popular usages for unmanned aircraft system applications. The current trajectory of research and application is aiming towards how to predict biomass of crops and assess nutrition levels within the soil and plants alike. Studies are discussing how to best proceed from this point forward, but some studies are showing that they were "able to map soil organic carbon levels in fields using support vector machines with data provided by a multispectral camera aboard a UAS." – Hassler. With these advancements being made in the fields of agriculture there is one such route that is often overlooked, weed management.

As our society transitions to a more sustainable and organic path, the old use of tractor-type sprayers is being brought into the spotlight for questioning. It is without question that many scientists are seeing the possible benefits to unmanned aircraft systems and weed management. Currently, there is a project which plans to build weed maps for various crops, such as wheat and cranberry bogs. As of 2018, there is a new application being brought forward that iscalled Thistle Tool which can be implemented with only RGB imaging from an unmanned aircraft system. With this camera and program, one can accurately determine where weeds are likely to sprout and where chemical application is needed.

Chemical application is one of the major components of agriculture before the harvest season but after the initial planting season. If fields are left unattended, they will quickly become overrun with weeds and are not suitable for the coming fall harvest. According to Hassler,

> Modern agriculture has nearly become synonymous with chemical usage, as it is crucial to almost every sector and crop. Therefore, the many disadvantages involved with chemical use should be constrained as much as possible. Unmanned aircraft systems equipped for chemical spraying have been proven to eliminate many of these disadvantages such as terrain limitations of ground-based sprayers; chemical exposure risks for farmers/workers; and with proper use, UAS sprayers can be more effective and economical than traditional methods. For example, Mink and his colleagues were able to save 90% of herbicide in maize fields and 43% of herbicide in sugar beet fields by using site-specific weed control methods via UAS.

There is a market to be had in the chemical applications via unmanned aircraft systems, traditional methods include, as discussed, pull-type sprayers and air tractors. Both of which rely on whole field applications consume copious amounts of fossil fuels. Unmanned aircraft systems should be able to initially lighten the load of chemical applicators through the use of automation andprecision application.

The future is looking bright for aviation and agriculture alike, as these two paths continue down the same route one can only help but think about what next great advancements will be made. One can only hope that as unmanned aircraft systems and technologies become more available to those who can utilize them that there will be a growing increase for Part 107 licensed

UAS operators and drones of that nature alike. Our society will thank us for making agriculture more sustainable and the fields will return the favor will bountiful harvests.

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