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Drones

Agricultural Uses for Drones

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Drones, or unmanned aerial vehicles (UAV) or unmanned aircraft systems (UAS), come in many shapes and sizes. The technology that was first developed for the military has now been brought to the consumer level where they have been redesigned for new applications. These applications include photography and filmmaking, real estate, drone racing, search and rescue, shipping and deliveries, construction, scientific applications and agriculture. For any educational or commercial applications, drone operators must have a remote pilot certification.

Additional information on this topic can also be found in a video at:

https://www.youtube.com/watch?v=pHr4TVVVhlM

Drones and Sensors

Drones can capture images using the stock camera that comes with the aircraft. These cameras are similar to those we are familiar with and can produce images and video with good resolution. Drones can also be outfitted with sensors that can capture images at specific wavelengths of light, some that are outside the visible colors that we can see such as thermal or infrared. These sensors can range around $2,000 to $10,000 and may not have the best return on investment for the average farmer as compared to the stock camera.

Using Drones in Agriculture

Researchers are currently looking at different ways drones can be used in agriculture. While some of these applications may not be currently available to consumers, they may be in the future. Scientists compare data collected from the drone with data they collect on the ground (known as ground-truthing) to ensure they are related. The remainder of this factsheet identifies different applications where scientists are using drones in agriculture.

Plant population and Plant health: Plant population, plant health or plant cover data can also be collected using a drone (Fig. 1). This data can help make replanting or application decisions early in the season.

Fig. 1. Drones can be used to estimate plant population.

Crop yields: Images can be used to estimate crop yields later in the growing season. In one example, scientists, using images collected from the stock camera, were able to determine plant biomass in a field of barley by using a drone to measure plant height (Bendig et al., 2014).

Soil mapping: Data collected using drones can help monitor different soil characteristics. These maps would have greater spatial resolution or detail than typical grid soil sampling. One group of researchers used the blue wavelength of light to create landscape maps showing changes in organic matter, potassium content and pH across a field (López-Granados et al., 2005).

Plant diseases: Drone imagery can be used to identify plant stress caused by disease. One study found that canopy temperature or a comparison of images that captured red light and green light reflected from the plant could be good estimates of downy mildew prevalence (Calderón et al., 2014)

Weeds: Spectral data from drone images can be used to assess weed prevalence and differentiate weeds from crops. Drones can be used to identify weed locations and create site-specific treatment maps that can be uploaded into GPS systems in applicator equipment to determine variable rates of herbicide applications. One study was able to get 91% weed detection accuracy in a sunflower field at 50 days after planting using red and near infrared wavelengths of light which are part of a common vegetation index called NDVI (Peña et al., 2015).

Irrigation: Drones equipped with thermal infrared cameras can be used to identify water deficits caused by irrigation issues. Similar to disease presence, the higher canopy temperatures can be used as an indicator of stress in plants and can be helpful in troubleshooting these issues.

Field damage: Drones can be used to identify different types of damage in the field. Researchers found that wild hog damage, which led to estimated losses of $26 million in Tennessee according to the Tennessee Wildlife Resources Agency in 2015, could be identified and differentiated from other types of damage using the stock camera that comes with the drone (Samiappan et al., 2018). Drones can also be useful in identifying the location of wind, hail and flood damage in a field and providing specific areas for insurance adjustors to visit which can result in greater returns.

Nursery/Forestry: Drones, along with the stock camera that comes with them, have been used to determine tree height and volume (Torres-Sánchez et al., 2018). This can help to identify specific management operations like pruning or fungicide applications and reduce costs. If used over multiple years, they can identify certain trees that are not growing as quickly as others.

Nutrient management: High resolution drone data allows farmers to monitor crop vigor at various growth stages. One study used drone data collected in the near infrared and "red edge" light regions for a vegetation index called Normalized Difference Red Edge (NDRE) in a corn field at V12 stage (Thompson et al., 2017). They created a variable nitrogen fertilization rate based on the data and saved about $3/acre with no change in yield.

Animal production: The stock camera that comes with a drone can be used for monitoring animals and checking water sources and fencerows. The time savings involved can allow for more regular checks that could potentially reduce animal mortality or costs/damages from escaped livestock.

Besides using the cameras or sensors attached to drones, other uses for drones have also been identified:

Applicators: Drones can be used as applicators for herbicides and other chemicals. Larger drones may be necessary to carry the greater payload required. For example, one current variable rate applicator drone on the market (DJI Agras MG-1) is just under 20 lbs (without batteries) and contains a 2.5 gallon tank that can spray a swath of 13 to 20 feet and cover 7 to 10 acres/hour.

Predation: Drones can be used to reduce losses incurred due to predation. One study found that multirotor drones may reduce predation of sunflower by birds, particularly at lower altitudes (50 ft) (Wandrie et al., 2019).

For more information

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