# UAVs for Specialty Crops

## A Startup Guide

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**Wael Elwakil**
Extension Agent, Fruit and Vegetable Production, UF/IFAS Extension, Hillsborough County, Seffner, FL 33584

**UAVs (Unmanned Aerial Vehicles) or UAS (Unmanned Aircraft Systems) also known as Drones,** is a huge industry that has been developing rapidly since the early-mid 2010s and is utilized in many sectors including agriculture. While the use of drones in Ag is relatively new in the commercial space, they are being quickly adopted for imaging, aerial pesticide and fertilizer applications, herding cattle, inventories, and many other applications.

### Uses and Benefits to Crop Producers:

Drones offer significant benefits to crop producers, particularly in aerial imaging and chemical or fertilizer applications. Imaging has versatile uses ranging from marketing, monitoring properties and inventorying, herding cattle, and plant health monitoring. A unique example we have used drones for is evaluating irrigation networks during freeze protection activities (Fig 1).

**Figure 1:** Problematic overhead irrigation system in operation that is resulting in crop damaging hard freeze/frost, which is otherwise extremely difficult to evaluate on the ground. Whitish circles on the left are hard ice formations damaging buds, flowers and fruits which can be an indication of low water pressure or defective overhead irrigation sprinklers. Credit W. Elwakil, UF/IFAS.

### Imaging Sensors for Agricultural Applications:

**1-RGB sensors** capture images as our eyes would see them or as regular cameras. They can detect a mix of colors (a spectrum of Red, Green, and Blue colors, hence the name RGB). Because they can only see the interpretation of colors as we would normally see with our eyes, they can only see the plant problems after they occur. But they can offer a wider image perspective highlighting the intensity and distribution of plant problems in the field.

**2-Multispectral sensors** are composed of multiple individual light sensors, each capturing a specific spectral band of reflected light from the plants or other surfaces. Multispectral sensors include Red, Blue, Green, Red Edge, Near-infrared (NIR), and Thermal Infrared (Fig 2).

**3-Hyperspectral sensors** collect much more detailed information through the electromagnetic spectrum of each pixel. They collect images constructed from hundreds of narrow bands (many more than the multispectral sensors). These images offer more differentiation due to the large amounts of information collected and can be used to differentiate between plant species, for example. This technology has tremendous potential and is currently used in research and natural areas mapping. It is however, greatly expensive comparatively and requires specialized data analysis platforms.

### Plant Health Monitoring:

RGB imaging can be used to give an overall bird's eye view of the conditions in the field, and when coupled with color filter analysis, it can give a very good perspective on plant health, distribution, and spread of plant stressors (Fig 3). Multispectral sensors have a great advantage over RGB as they can detect plant health issues or stresses early since they detect reflected light bands instead of just interpreting colors like RGB sensors. Essentially the less reflected light from the plant's surfaces, the

more light is absorbed by chlorophyll, which is an indication of healthy plants, and vice versa.

### Aerial Product Applications (Spray Drones):

Aerial application of liquid or dry chemicals (crop dusting) has been very popular in large acreage crop production systems for over a century. Aerial drone applicators are new to this scene. Drone application of liquid or dry pesticides or fertilizers has limitations due to equipment capacity, FAA regulations, current cost, and the technical knowledge required for operating these UAVs. However, they can be extremely beneficial to complement existing ground based and aerial application systems. Spray drones can effectively perform niche applications in small scale acerage, irregularly shaped farms, roadsides, hazardous areas, aquatic bodies, and public health operations. Currently the number of spray drone service providers is increasing all around the US, with many more operators and providers needed in the future.

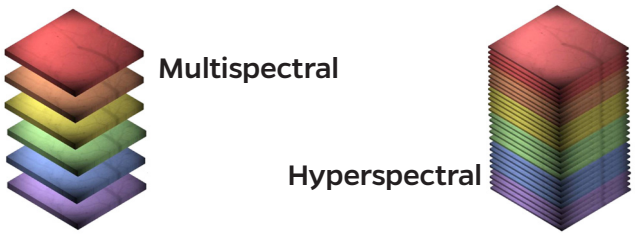


**Figure 2:** Light spectral bands illustration of multispectral and hyperspectral imaging.
Adapted from Giannoni *et al* 2018.

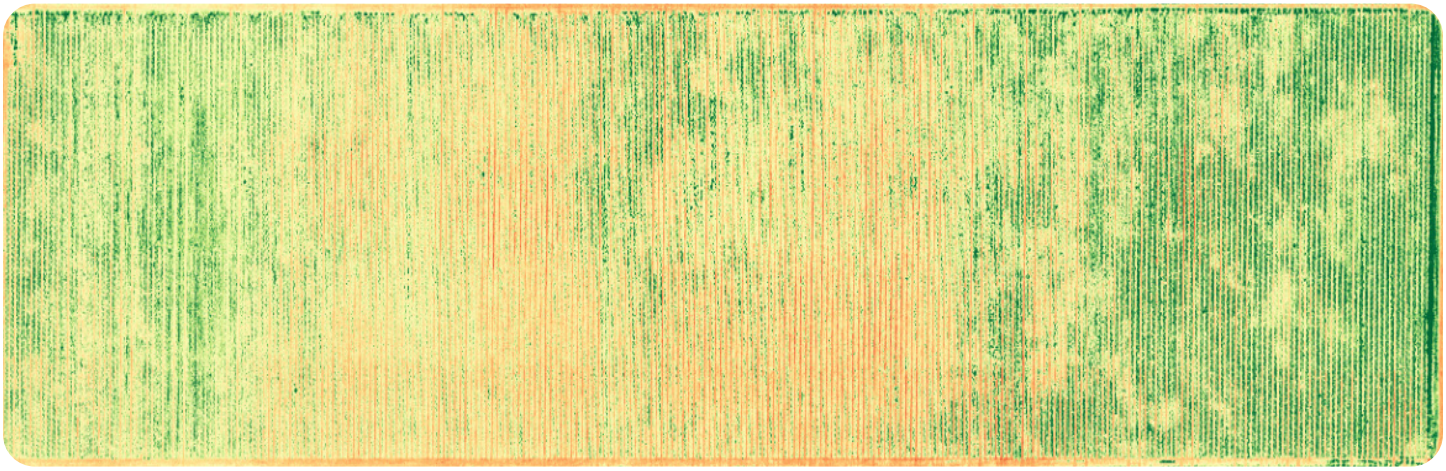

**Figure 3:** RGB image with an NDVI (Normalized Difference Vegetation Index) color filter which shows the distribution and intensity of damage caused by sting nematode in a strawberry production field. Reddish or lighter green areas have lesser canopy coverage or stresses plants. Note that the damage is visible to the naked eye. Credit W. Elwakil, UF/IFAS.

### Getting Started!

It can be overwhelming considering all the hardware and software options due to the rapid movement of technology and industry advancements, not to mention the legality of using drones professionally and safely operating in the different air spaces. Also, contracting a drone service provider may or may not make sense financially depending on the type of service and the acreage. For these reasons, those interested in using drones should consider their needs and develop a tailored, cost-effective, and operationally feasible plan to achieve their goals. We are available to advise growers to develop the best plans to suit the specific production systems.

### Concluding Thoughts:

Collaborate with local extension experts to develop a customized drone plan suited to your production needs. Start with basic systems like RGB and expand as necessary while ensuring compatibility between hardware and software. Evaluate drone services for operational feasibility before making investments.

**References:**

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