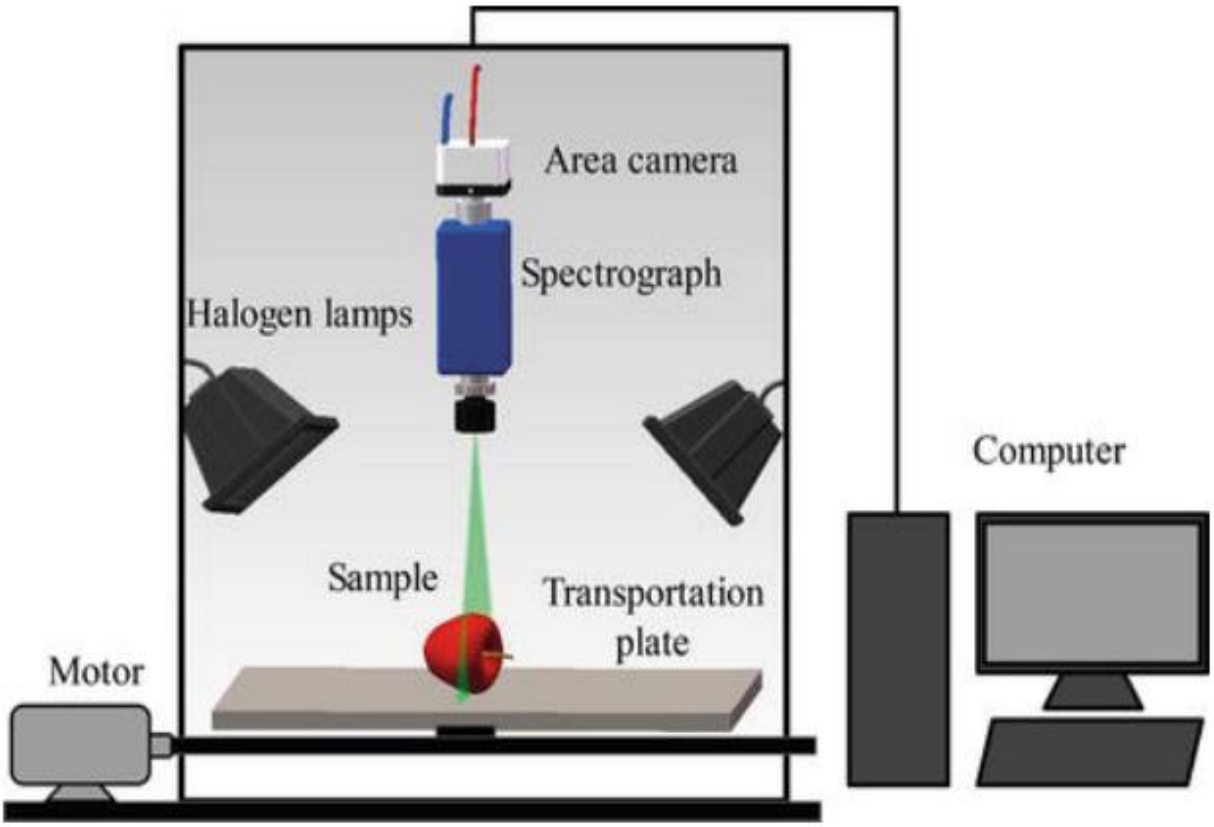
The Hyperspectroscopy in Agri and Food Tech

Hyperspectral imaging or imaging spectroscopy is a novel technology for acquiring and analysing an image of a real scene by computers and other devices in order to obtain quantitative information for quality evaluation and process control. Hyperspectral imaging has attracted much research and development attention, as a result rapid scientific and technological advances have increasingly taken place in food and agriculture, especially on safety and quality inspection, classification and evaluation of a wide range of food products, illustrating the great advantages of using the technology for objective, rapid, non-destructive and automated safety inspection as well as quality control.



World- Top 10 world best known AgriTech companies using hyperspectroscopy

1. FluroSat
FluroSat uses satellites, drones, and some aerial imagery, to capture and analyze hyperspectral images of crops to predict disease and help growers make decisions.
url: https://flurosat.com/
CEO - Anastasia Volkova

2. Gamaya
Develops a farming management solution using hyperspectral imaging and data analysis.
url: https://gamaya.com/
CEO - Mathieu Hagen

3. FruitSpec
Scan the trees in an orchard, counting and map out the number of fruit still ripening up behind their leaves, as well as estimating fruit sizes.
url: https://www.fruitspec.com/
CEO -Raviv Kula

4. ChrysaLabs
Soil Mapping, measure soil nutrients, pH, moisture, and organic matter.
url: https://www.chrysalabs.com/
CEO - Samuel Fournie

5. Fotenix
Crop Analytics
url: https://fotenix.tech/
CEO - Charles Veys

6. Polariks
Quality Monitoring, help vineyards improve their harvest
url: https://www.polariks.com/
CEO - Scott Wine

7. BharatRohan
Drone-based hyperspectral solutions for precision agriculture, pick up physiological changes that are not visible.
url: http://bharatrohan.in/
CEO - Amandeep Panwar

Top 3 Indian Agri Tech Companies using hyperspectroscopy

1. TartanSense Analyzing health of plants using drones
url: http://www.tartansense.com/
CEO - Jaisimha Rao

2. BharatRohan
Drone-based hyperspectral solutions for precision agriculture, picks up physiological changes that are not visible yet.
url: http://bharatrohan.in/
CEO - Amandeep Panwar

3. Agricx Lab Quality analysis from an image of the product sample
url: http://agricx.com/
CEO - Saurabh

MicaSense RedEdge MX Multispectral Sensor

The RedEdge-MX is a rugged and precise multispectral camera for advanced agricultural analysis. This high-performance tool captures both the spectral bands required for crop health indices (green, red, red edge and near-infrared), a blue band for deeper insights into specific issues, plus composite RGB imagery.

Specifications

Weight	231.9 g (includes DLS 2 and cables)
Dimensions	8.7 cm x 5.9 cm x 4.54 cm
External Power	4.2 V DC - 15.6 V DC 4 W nominal, 8 W peak
Spectral Band	Blue, green, red, red edge, near infrared (NIR) (global shutter, narrow band)
Wavelength (nm)	Blue (475 nm center, 32 nm bandwidth) Green (560 nm center, 27 nm bandwidth) Red (668 nm center, 16 nm bandwidth) Red Edge (717 nm center, 12 nm bandwidth) NIR (842 nm center, 57 nm bandwidth)
RGB Colour Output	Global shutter, alligned with all bands
Ground Sample Distance (GSD)	8 cm per pixel (per band) at 120 m (above ground level)
Capture Rate	1 capture per second (all bands), 12-bit RAW
Interface	Serial, 10/100/1000 ethernet, removable Wi-Fi, external trigger, GPS, SDHC
Field of View	47.2° HFOV (Horizontal Field of View)
Triggering Options	Timer Mode, Overlap Mode, External Trigger Mode (PWM, GPIO, serial, and Ethernet options), Manual Capture Mode
Heat	0-40° C ambient (no airflow) 0-50° C ambient with airflow > 0.5 m/s

Key Features

- Five narrow spectral bands captured during flight.
- Huge image resolution; 8 cm/pixel at 120 m (above ground level)
- Single SD card stores all images with geotags.
- Standalone operation, with optional external trigger and data from host aircraft.
- Web-based configuration page accessed from any Wi-Fi capable device.
- Embedded mounting points for easier integration.
- Global shutter imagers - doesn't require gimbal.
- From one flight gives gain insights from RGB, vegetation indices, and digital surface models.
- Platform-agnostic data and integration
- DLS 2 with embedded GPS

Key Benefits

- New aluminum body for better durability and performance in the heat.
- Compact size allows for integration with a wide variety of drones.
- Calibrated for precise, repeatable measurements.
- Wide voltage range to handle more integrations without extra power conversion.
- Rugged design with no moving parts.
- Full access to raw data; outputs can be generated using a wide variety of processing and analysis platforms.

Areas where RedEdge-MX can be of potential use

1. **Phenotyping:** Manually measuring plant characteristics is time-consuming. RedEdge-MX captures more data in less time, allowing researchers to understand how different breeds react to certain environments and modify desirable traits in order to improve yield.

2. **Crop Health Mapping:** Low chlorophyll content is often an early indicator of plant stress. RedEdge-MX captures both visible and invisible spectral bands. From the different bands, it is possible to generate indices to see individual chlorophyll levels in the plants and compare over time.

3. **Water Management:** RedEdge-MX can provide powerful insights into water management. For example, color composites using the NIR band (like CIR) can help users identify overly damp areas. In addition, areas that are benefiting from excess irrigation will be highlighted.

4. **Fertiliser Management:** RedEdge-MX not only allows for easy identification of areas low in nutrients but also help monitor the effects of fertilizer applications throughout the season and determine if, when, and where a new application is needed.

5. **Disease Identification:** RedEdge-MX captures a critical part of the light spectrum for studying plants (712–722 nm), called the red edge band. It is in this section of the spectrum that the first signs of stress start to show. Using analytics generated with the red edge band, growers can identify disease sooner and act faster to stop the spread.

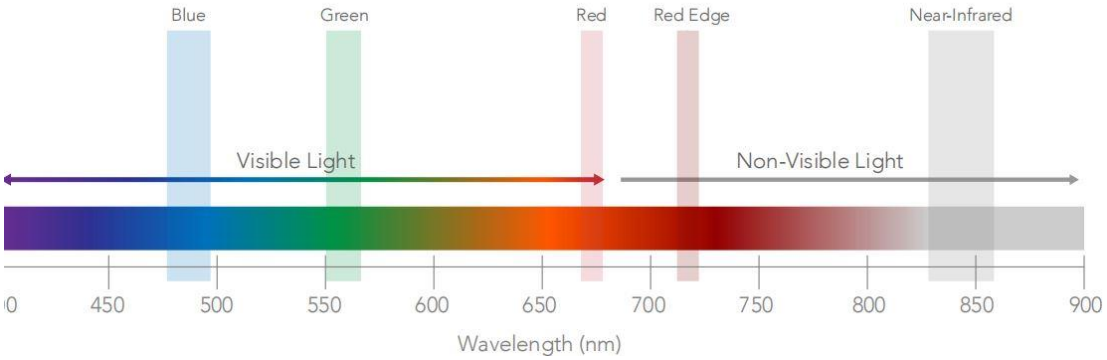
6. **Species Differentiation:** Some differences among species may not be visible to the naked eye. High-quality multispectral data allows for species differentiation by highlighting characteristics such as chlorophyll content, vigor, and leaf size.

7. **Weed Detection:** Analytics developed with multispectral data can identify and highlight weeds, as weeds may have a different spectral signature than the planted crop.

8. **Advanced Crop Scouting:** High-quality multispectral imagery provides advanced field scouting capabilities. In one flight, it is possible to collect accurate and geotagged information of a problem, making easy to assess the situation and determine the appropriate intervention.

9. **Terrain Modeling:** One of the advantages of a calibrated multispectral sensor is the generation of aligned outputs, which can be used to create digital surface models (DSM). A DSM provides insights into water management, land uses and terrain elevation.

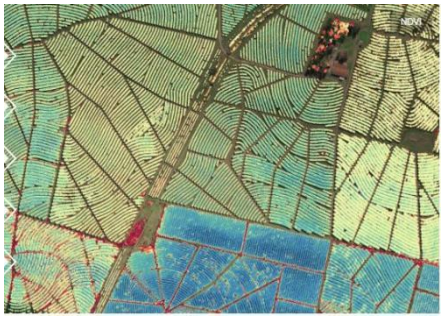
10. **Leak Scouting:** By measuring the reflectance on the red edge band, RedEdge allows the detection of irrigation leaks. The reflectance of the plants located in the areas with excessive irrigation varies from the rest of the field, oftentimes appearing healthier and showing high NDRE values.



RGB Imagery

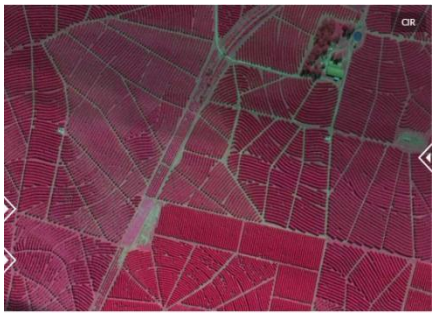
Color or RGB (red, green, blue) images are useful to recognize symptoms of diseases, nutrient deficiencies, damaged plants, specific weeds and plant species in crop fields. The appearance of an object in RGB images is the result of the light reflected from the object, its optical characteristics, and the human perception. RGB-based image analysis has been applied in agriculture for weed discrimination weed and crop mapping, variable physiological process across a leaf surface, and plant stand counting.

Multispectral Imagery



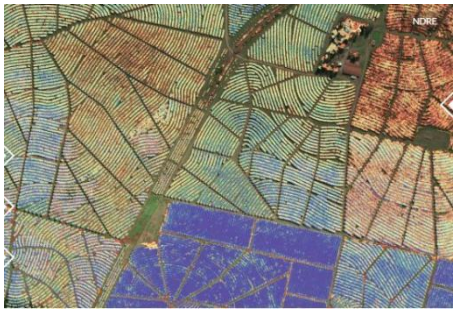
Multispectral images consist of spectral information of objects in several spectrum wavebands. Multispectral sensors usually detect spectral information of red, green and blue electromagnetic spectrums, and also the red edge and near-infrared wave ranges. Developing vegetation indices such as normalized difference vegetation index (NDVI), and band ratio are two powerful method for multispectral image processing. These methods can be used to identify crop health, weed species, crop injury after herbicide spraying and diseases symptoms.

CIR Imagery



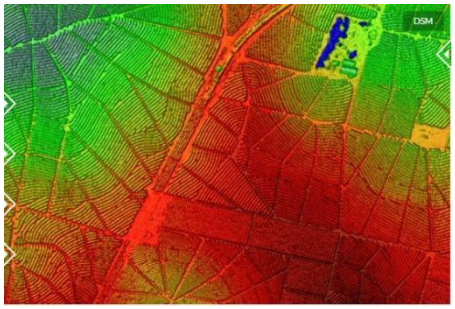
CIR imagery offers growers a comprehensive first look at a recently planted field by revealing which areas of a field experience the first plant emergence, as well as the uniformity of that initial growth. On bare ground, CIR imagery also offers a quick and cost-effective method of soil mapping.

NDRE Imagery



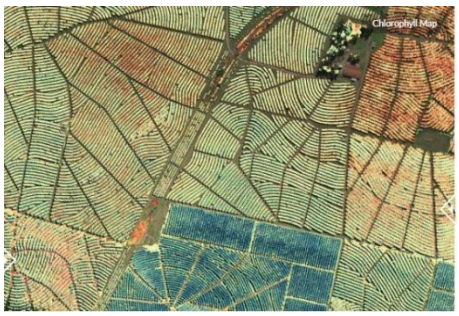
NDRE is a better marker of plant conditions than NDVI for middle and late season crops that have already accumulated a large amount of chlorophyll. The reason is that red-edge light (the one used in NDRE) can pass through the leaves far deeper than red light (the one used in NDVI). It's more relevant than NDVI for intensive use during the entire cultivation season, as NDVI often becomes inaccurate after plants accumulate a maximum amount of chlorophyll content.

DSM Imagery



The DSM will represent the height, above mean sea level, of the features in the image (e.g., the crops, buildings, trees). The DSM can further be used to derive crop canopy height and 3D models of the mission area.

Chlorophyll Imagery



Drones used by Multiplex Drones Private limited

Model	Purpose used	Weight	Take-off Weight	Max Take-off Weight
MD-5	Agricultural Spraying	5.8 kg (no battery) 14 kg (Full Loaded)	15 kg	15 kg
MD-10	Agricultural Spraying	10 kg (no battery) 24 kg (Full Loaded)	24 kg	28 kg
MD-10 Pro	Agricultural Spraying	10 kg (no battery) 24 kg (Full Loaded)	24 kg	28 kg
MD-20	Agricultural Spraying	22 kg (no battery) 53 kg (Full Loaded)	53 kg	55 kg

Source: https://micasense.com/rededge-mx/