![APPN Australian Plant Phenomics Network logo]

# UAV-based Field Phenotyping

Uncrewed aerial vehicle (UAV) based field phenotyping is a key aspect of APPN's flexible, high throughput digital phenotyping capability. Multiple UAVs are available as part of the Mobile Phenotyping Units at APPN nodes across the country. These UAV's can mount a range of sensors including RGB, multispectral, hyperspectral and LiDAR. Flights are conducted by our skilled and licensed operators, and fully supported by sophisticated data processing and analysis pipelines.

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# UAV-based Field Phenotyping

APPN's UAV-based field phenotyping capabilities allowing for rapid phenotyping of crop performance. We provide:

- Several UAV platforms capable of carrying a range of sensor packages.
- Sensor options that include high resolution RGB, multispectral, hyperspectral and LiDAR.
- Skilled operators to fly missions following protocols optimised for a range of agricultural and horticultural scenarios.
- Expert image analysts who can use the multimodal sensor data to develop models for a wide range of crop performance traits (nutrition, disease, phenology etc.).
- FAIR data processing pipelines enabling the delivery of quality data.

## About

UAVs offer a high throughput and cost-effective means of phenotyping field-based research trials.

UAV-based phenotyping is able to acquire images for hectares of field trial crops in a single mission. Each flight can deliver basic information about trial quality, plant height, fractional cover, biomass proxies, plant stress indicators and more. Multiple missions over a field trial can also allow monitoring of growth rates.

When combined with ground truthing, the data from sensors can also be used to develop models for quantifying specific traits within the trial plants, such as nutrition, phenology, disease, yield components, water content, and so on.

UAV platforms are located with APPN's mobile phenotyping units based at UWA in Perth, DPIRD WA in Northam, UoA in Adelaide, CSU in Wagga Wagga, USyd in Narrabri and UQ in Gatton.

## Available technologies

Our base platform is the DJI Mavic 3M UAV with a 20MP RGB camera and a 4-band multispectral sensor.

Higher-spec UAVs are based on the DJI M350 UAV fitted with a GRYFN GOBI sensor package. This package integrates a high-resolution Sony ILX-LR1 digital camera, Ouster LiDAR sensor and a Headwall Nano HP VNIR hyperspectral sensor (400-1000nm). The GOBI system also includes fully integrated capture and processing software.

Together these UAVs and sensor packages cover a wide range of UAV applications in agriculture and horticulture.

## Operations

Each of our Mobile Phenotyping Units has skilled operators to fly the UAVs following APPN protocols. These protocols align with world's best practices and have been refined to suit the requirements of typical crop field trials in Australia.

Once data has been collected it is processed using reproducible and well documented analysis methods with support from the APPN data team. Expert analysts are available to develop models for specific traits and the team are happy to consult on what traits are suitable for model development and what is required for the development of robust models.

### Technical Details

**DJI Mavic 3M**
- Hasselblad 20MP
- 4 band multispectral (green, red, red edge, NIR)

**Gryfn Gobi**
- DJI M350 UAV
- RGB: Sony ILX-LR1 61 MP
- LiDAR: Ouster OS1
- Hyperspectral: Nano HP (400-1000nm)

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