

eBee X Fixed Wing Endurance Drone (90 mins flight time)

Precision targeting using Drones, advanced Soil testing, and Beneficial Bacteria to target pathogens:

Precision analysis > More informed decision making > Increase yields > reduce costs



DUET M – Multispectral & RGB SODA Camera



AERIA X – High Definition RGB Camera



DUET T – Thermal & RGB SODA Camera

Precision Targeting using Drones, Advanced Testing techniques & Biofertilisers

1. Drones in Agriculture
2. Soil Health and Management of pathogens through Bacteria infused biofertilizers.
3. AI Yield estimation & Bird Scaring techniques



Then & Now:

2019



2023



Precision Targeting using Drones, Advanced Testing techniques & Biofertilisers

Drones in Agriculture



How Drones Support Nut Nutrition & Yield Management

1. Nutrient Deficiency Detection (Multispectral/NDVI)

- **Multispectral drones** detect early signs of nutrient stress—such as **nitrogen, potassium, or magnesium deficiencies**—before symptoms appear to the human eye.
- **NDVI/NDRE maps** identify underperforming zones for **targeted fertilization**.

2. Canopy Health Monitoring

- Drones monitor **canopy density and uniformity**, helping identify:
 - Water stress
 - Disease pockets (e.g. blight)
 - Vigor variability due to soil nutrition imbalance

3. Variable Rate Fertilization

- Drone imagery informs **variable rate application maps** for:
 - Fertilizers
 - Lime or gypsum
 - Organic soil amendments
- This minimizes over- or under-feeding, improving both **yield and input efficiency**.

4. Yield Prediction & Crop Estimation

- High-resolution drone imagery estimates **flower density, fruit set, or canopy load**, which correlates with yield.
- Machine learning models can be trained to predict **zone-by-zone yield potential**.

5. Orchard Mapping & Tree Counting

- Orthomosaic maps and AI tools can **count individual trees, assess growth stages, and detect gaps or replants** for better orchard planning.

6. Soil Variability Mapping (with thermal or near-infrared)

- Drones help map **soil moisture, compaction zones, or root stress**, especially in irrigated nut orchards.

7. Disease and Pest Outbreak Detection

- Early detection of **blight, mites, or borers** through discoloration or canopy thinning.
- Allows **localized intervention** instead of whole-block spraying.

Drone-enabled Big Bud Mite (BBM) program (RGB, EO, multispectral)

What you can (and can't) see from the air

- **Direct buds:** BBM lives *inside* buds; you won't "see mites." What you *can* detect are **spatial hot-spots** of reduced vigor and patchy canopy following heavy bud loss.

Best signals:

- **High-res RGB/EO** (orchard-scale + telephoto sampling) to: (a) locate weak rows/trees, (b) zoom spot-check for swollen, unburst buds pre-leaf-out.
- **Multispectral indices** to quantify vigor differences that correlate with BBM pressure and nutrition/water stress that "attract" buildup.

Sensors & platforms (practical orchard picks)

- **Mapping / vigor: Multispectral** (built-in RGB+NIR; fast, orchard-friendly) or M350 + **RedEdge-P** for research-grade data.
- **Telephoto scouting: High Resolution Electro Optical Camera Drone** for **bud-level spot checks** in late winter without ladders.
- **Thermal (optional):** Helps find irrigation/valve issues that lead to humid pockets → mite-favourable microclimates.

NDVI: (Normalized Difference Vegetation Index) NDVI measures plant health by detecting how strongly a plant reflects near-infrared light

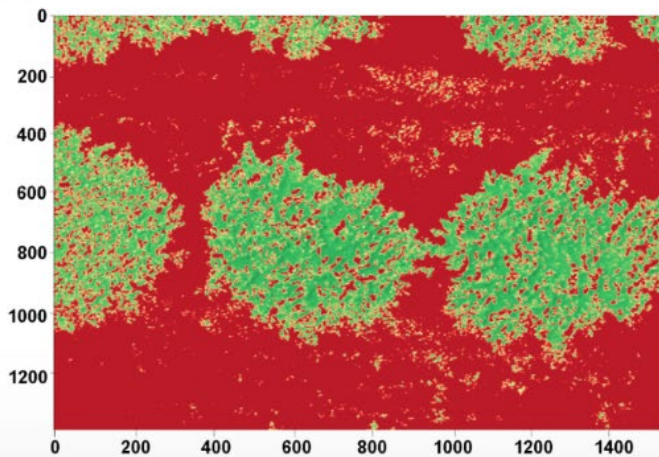
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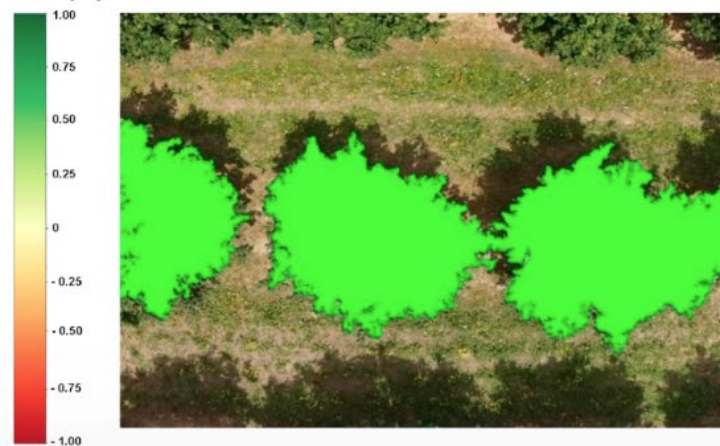
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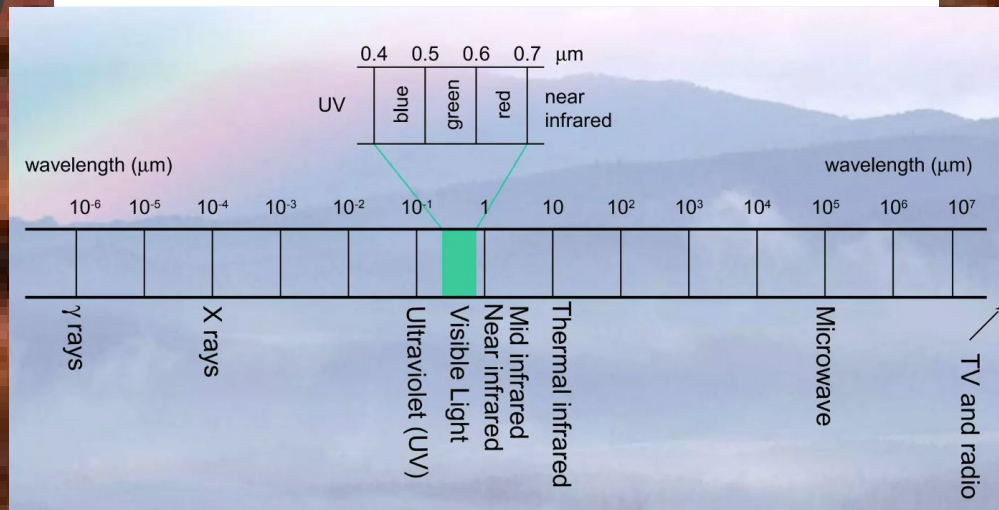
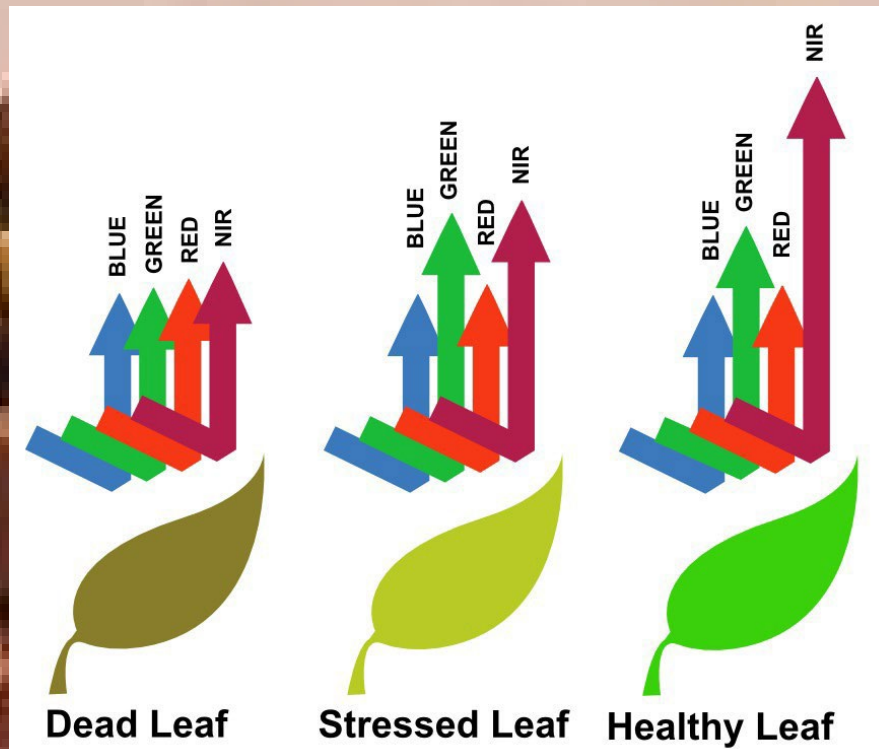
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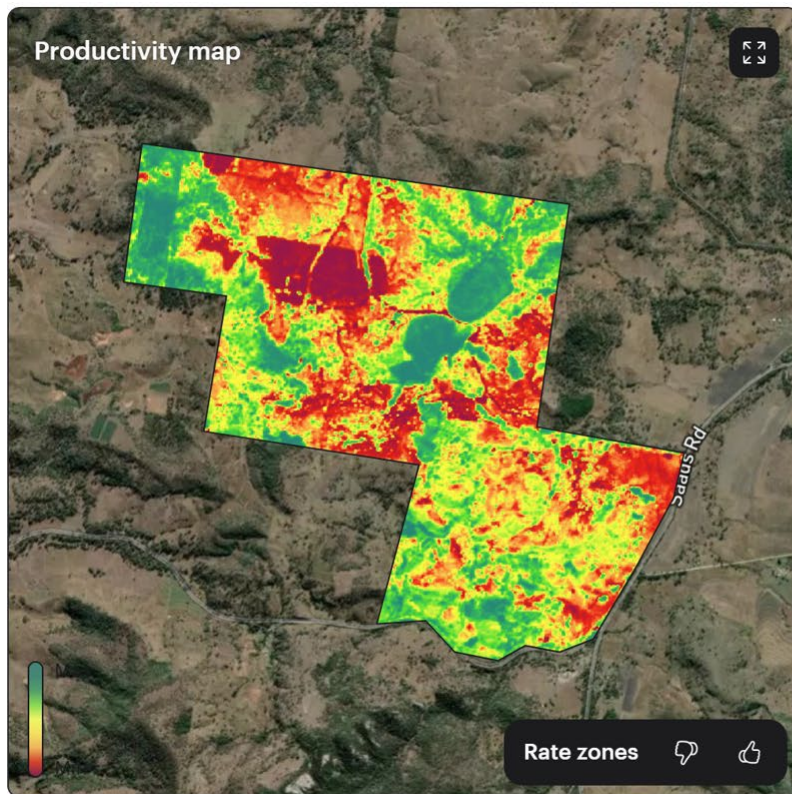


NDVI (MULTISPECTRAL) EXPLAINED



Factors that influence soil reflectance in remote sensing include: Mineral Composition, Soil Moisture, Organic Matter Content (NDVI), and Soil Texture (Surface) (Temperature)

NDVI EXPLAINED



55%

Field stable area

Areas of low and high productivity persisting from year to year.

9/13

Seasons used

Number of seasons used in the calculation of the productivity map.

Distribution of productivity zones

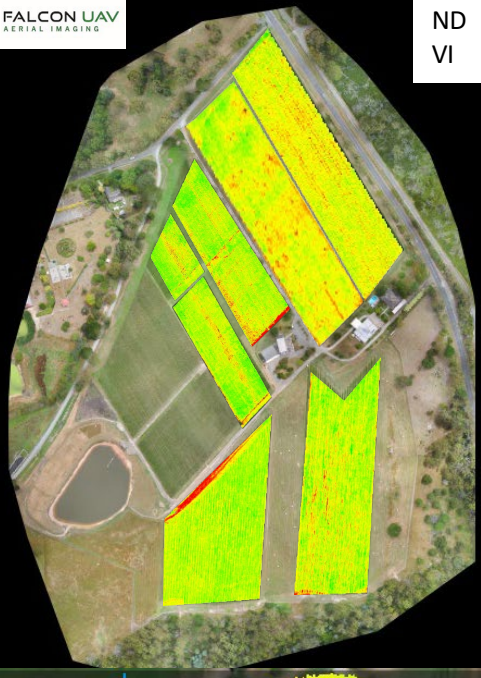
Productivity zone	Area	Yield deviation
High zone	244.4 ha, 26.1%	+41.0%
Medium zone	424.4 ha, 45.3%	0
Low zone	268.5 ha, 28.6%	-19.0%



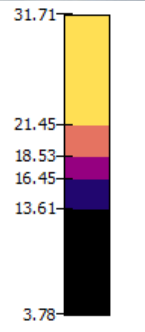
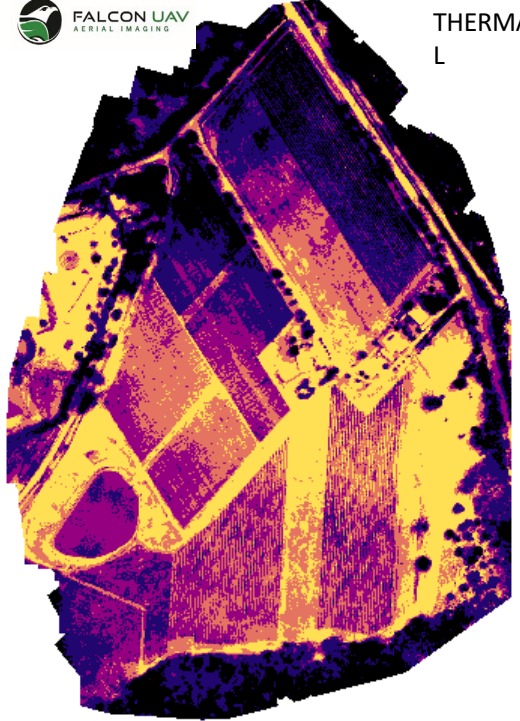
RG
B



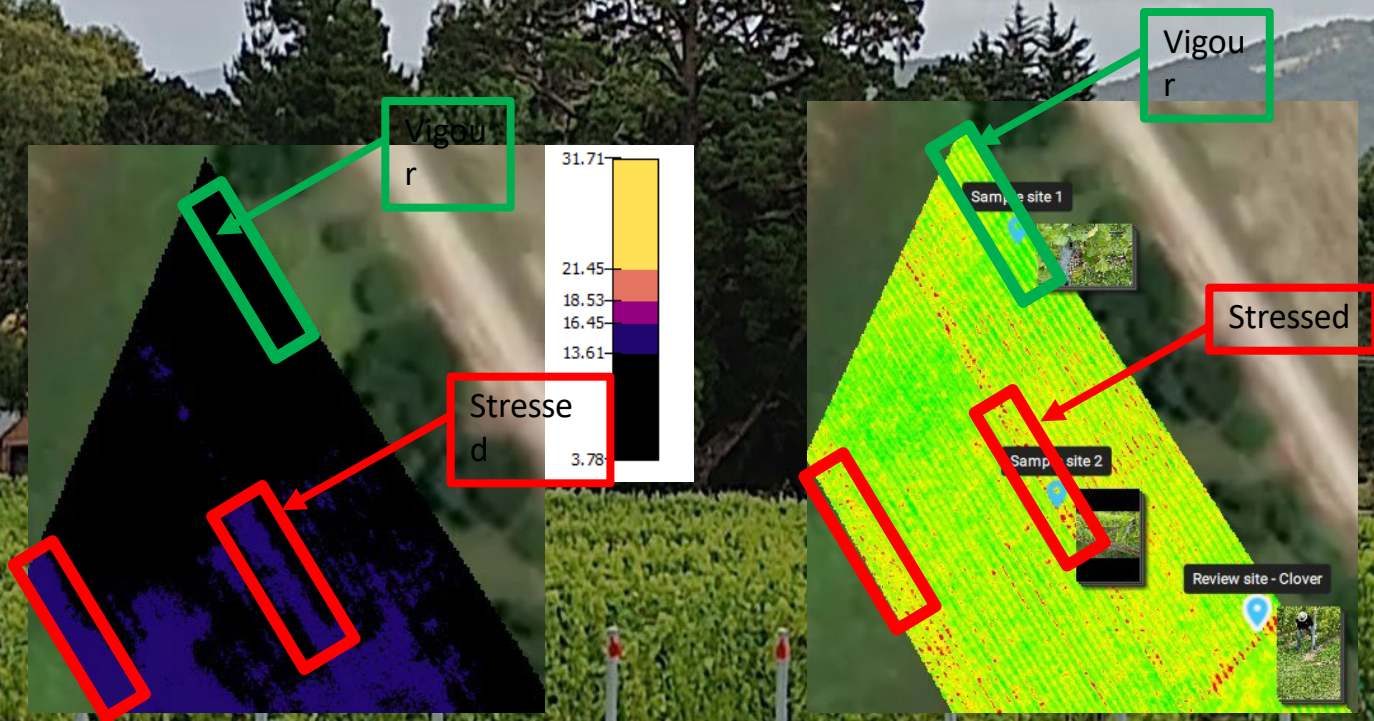
ND
VI

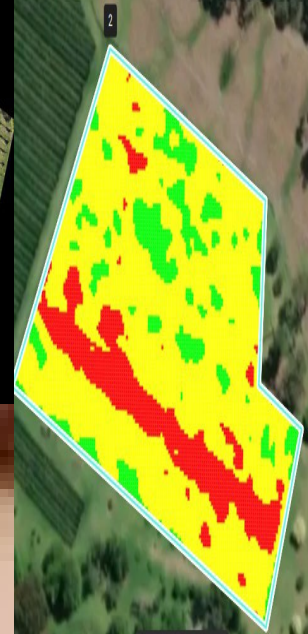
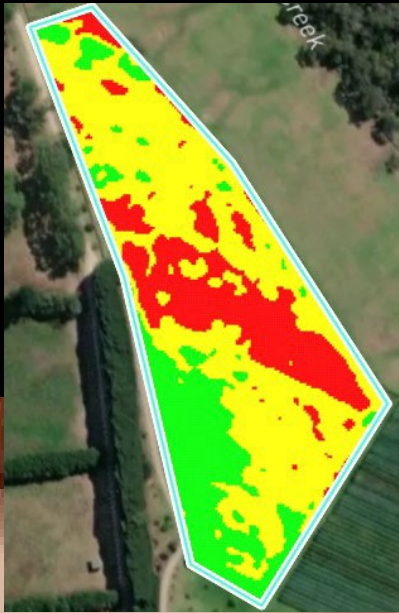
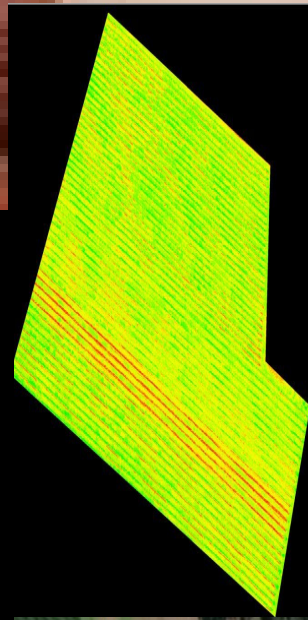
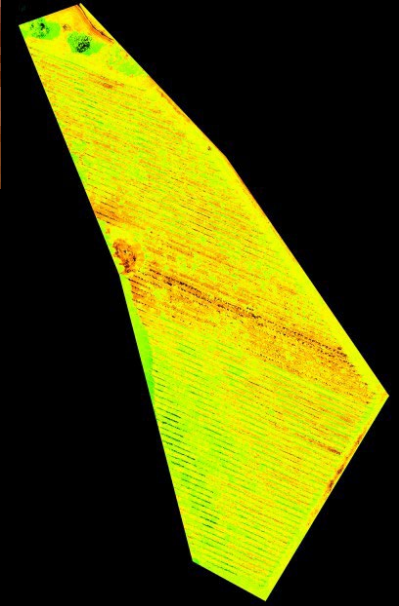
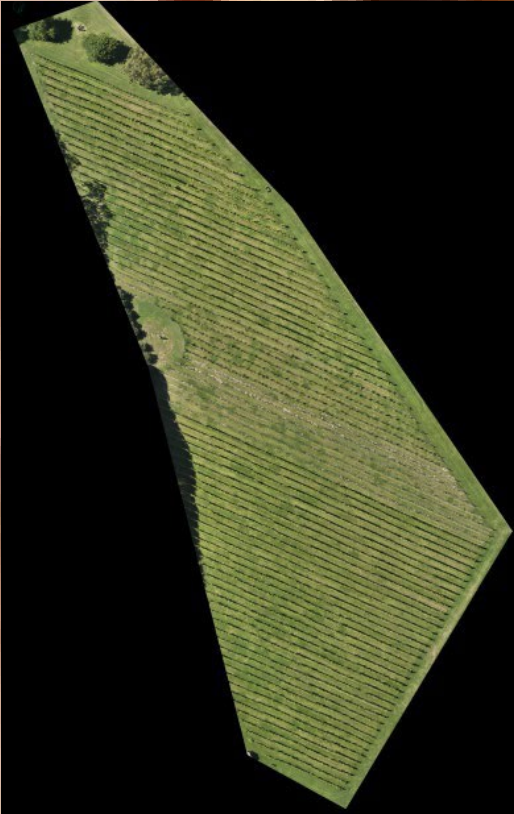


THERMA
L



Side by Side - Affect on thermal to vine health/vigour





Precision Targeting using Drones, Advanced Testing techniques & Biofertilisers

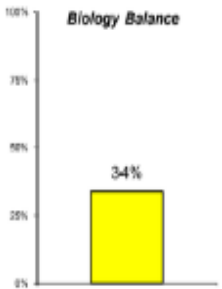
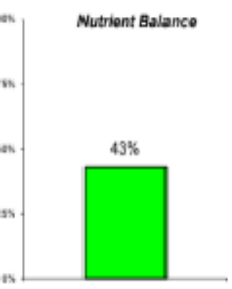
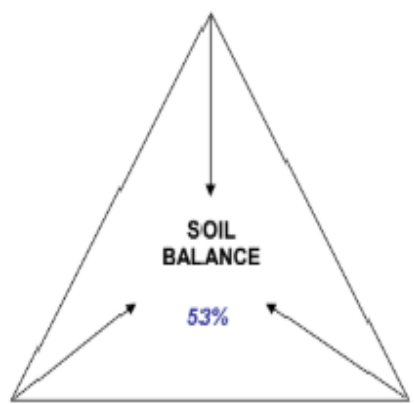
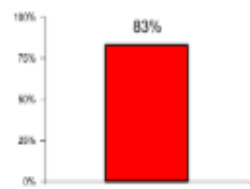
Soil Health and Management of
pathogens through Bacteria
infused biofertilizers



Soil Analysis: The Standard soil test analyses Ph, EC, TSS, T. Organic Matter, T. Organic Carbon, exchangeable cations (Calcium, Magnesium, Sodium, Potassium, and Hydrogen), Cation Exchange Capacity, Adjusted Hydrogen, Adjusted CEC, Cation percentages (of Adj. CEC) and available major and trace nutrients

Summary of Complete Soil Balance Status

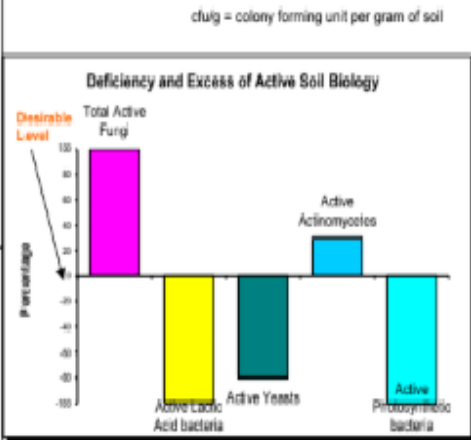
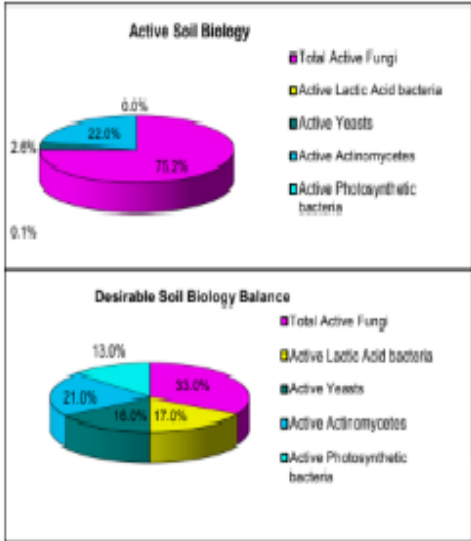
(Changes over time will indicate likely sustainability of production)



Overall Soil Balance Rating				
Poor	Below average	Average	Above average	Good
<20%	20%-40%	40%-50%	50%-80%	>80%

Biology Balance

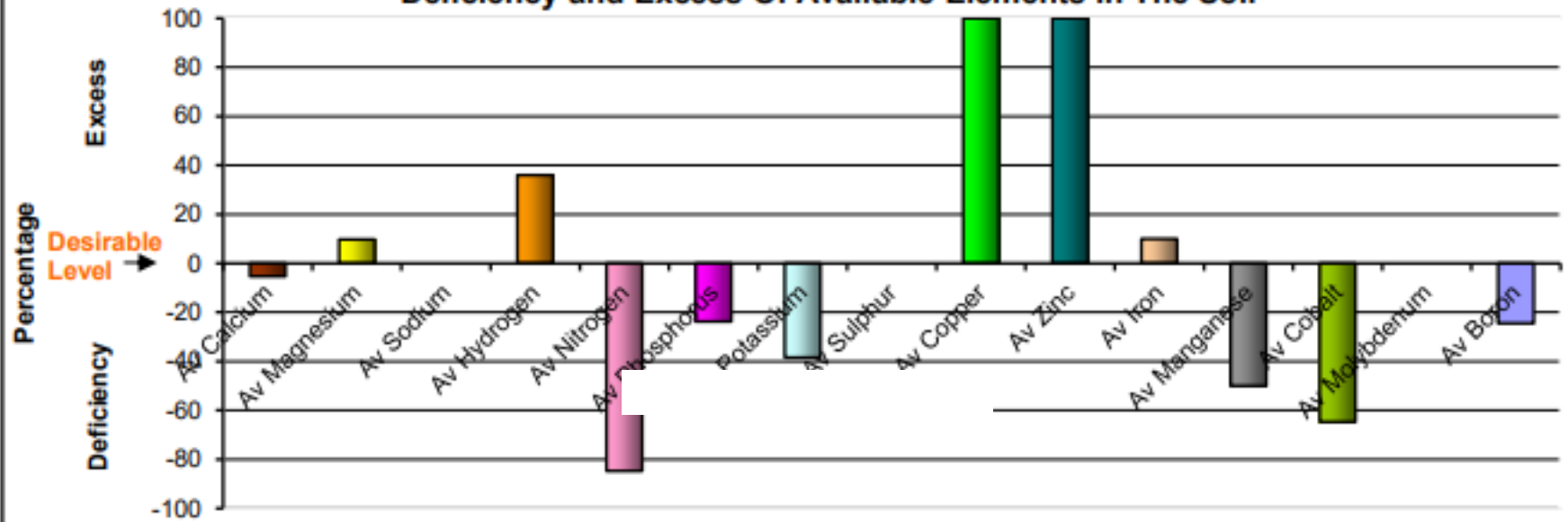
ITEM	Result	% of TAP	Desirable	% Desirable	
ACTIVE LACTIC ACID BACTERIA	cfu/g soil	1,000	0.1%	105,922	17.0%
Active Fungi	cfu/g soil	340,000			
Cellulose utilisers	cfu/g soil	240,000			
TOTAL ACTIVE FUNGI	cfu/g soil	580,000	75.2%	205,613	33.0%
ACTIVE YEASTS	cfu/g soil	20,000	2.6%	99,691	16.0%
ACTIVE ACTINOMYCETES	cfu/g soil	170,000	22.0%	130,844	21.0%
ACTIVE PHOTOSYNTHETIC BACTERIA	cfu/g soil	100	0.0%	80,999	13.0%
Total Active Population (TAP):	cfu/g soil	771,100		623,069	
CARBON/NITROGEN RATIO		11.3		10-15	



SOIL BIOLOGY MANAGEMENT (To help accelerate changes in soil structure and nutrient availability)

- Kelp extract: 5 litres/ha - To encourage Actinomycetes, Yeast, Photosynthetic and/or discourages Fungi
- Molasses or sugar: 2 litres/ha - To encourage Yeasts, Fungi & other fermenters
- Worm leachate: 10 litres/ha - To encourage Photosynthetic bacteria, Fungi and/or Actinomycetes
- Fish emulsion: 2 litres/ha - Helps improve the C:N ratio & discourages Lactic Acid Bacteria
- Liquified humate: 0 litres/ha
- Mulch or Green Manure: Beneficial - To encourage various Fungi

Deficiency and Excess Of Available Elements in The Soil



- Phosphorus fixation effects if Iron is more than 300 ppm
- Manganese will be at toxicity level if it reaches 500 ppm

Soilborne pathogens (or root / soil threats) that may contribute or cause losses, and how they might relate to hazelnut

Some soilborne or root/wood pathogens relevant to orchards (and possibly hazelnut) include:

- **Armillaria root rot** (e.g. *Armillaria novae-zelandiae*) — known in New Zealand and Tasmania/Australasia more broadly as a wood-decay pathogen. *Armillaria novae-zelandiae* occurs in NZ, Tasmania, and Eastern Australia.
 - The fungus persists in wood and roots, spreads by root contact or rhizomorphs, and can infect new trees planted near old stumps or affected wood.
- **General soil fungi** such as *Phytophthora* spp. (damping-off, root rots), *Rhizoctonia*, *Fusarium* spp., *Pythium* — common in many orchards; under poorly drained or wet soils these may stress roots and predispose trees to secondary problems.
- **Wood decay / canker fungi** — saprophytic or weak pathogens that may enter through wounds and degrade vascular tissue.
- **Nematodes** — in some soils, root-parasitic nematodes (e.g. *Pratylenchus*, *Meloidogyne*) can degrade root systems, though specific records in hazelnut in Australia/NZ are minimal or unconfirmed in published literature.
- **Soilborne bacteria** — less common, but certain opportunistic bacteria can infect roots under stress.

Because hazelnut roots are relatively shallow and fine, poor drainage, waterlogging, and compaction can exacerbate soilborne pathogen damage.

Pathogen detection:

CLADOSPORIUM ROT



WORLDWIDE INCIDENCE

(((c))) Widely spread

84 out of 100 parcels analysed are affected by Cladosporium rot

RISK LEVEL

VERY HIGH

! FEATURED MICROORGANISM FOUND
related to Cladosporium rot

Cladosporium herbarum • FUNGUS

PETRI DISEASE

TRUNK



WORLDWIDE INCIDENCE

(((c))) Widely spread

75 out of 100 parcels analysed are affected by Petri disease

RISK LEVEL

HIGH

! FEATURED MICROORGANISM FOUND
related to Petri disease

Cadophora luteo-olivacea • FUNGUS

Slight Risk Detected



BLACK FOOT DISEASE

||||| LOW Risk level



DOWNY MILDEW

||||| LOW Risk level



ALTERNARIA ROT

||||| VERY LOW Risk level



Not Detected

- ASPERGILLUS ROT
- BOTRYOSPHAERIA DIEBACK
- ESCA COMPLEX
- EUTYPA DIEBACK
- PHOMOPSIS DIEBACK
- PIERCE'S DISEASE
- RIPE ROT
- TEXAS ROOT ROT
- ANGULAR LEAF SCORCH / ROTBRENNER
- ANTHRACNOSE
- CROWN GALL TUMORS
- POWDERY MILDEW
- WHITE ROT
- ARMILLARIA ROOT ROT
- BOTRYTIS BUNCH ROT
- DEMATOPHORA ROOT ROT
- MACROPHOMA ROT
- PHYTOPHTHORA CROWN AND ROOT ROT
- VERTICILLIUM WILT
- BACTERIAL BLIGHT



In practice, Australian/Tasmanian hazelnut growers face:

- Leaf spots, fungal leaf diseases, perhaps opportunistic pathogens under stress
- Occasional bacterial issues (if introduced or under favorable conditions)
- Root rot or waterlogging diseases by general soil fungi (if soils are wet or poorly drained)
- Stress disorders (e.g. “blanks,” brown stain) of uncertain cause

Summary of major disease threats regionally

Region	Key diseases observed or potential	Primary pathogen type(s)	Notes
Australia / Tasmania	Leaf spots, opportunistic fungal diseases, possible bacterial under favorable conditions	Fungi, bacteria (less documented)	Many major hazelnut diseases not present; risk of introduction/exotics
New Zealand	Bacterial blight, hazelnut mosaic virus, leaf spots, twig/trunk infections	<i>Xanthomonas arboricola</i> pv. <i>corylina</i> , viruses (Ilarvirus)	Bacterial diseases are a significant issue in NZ orchards

New Zealand

New Zealand has a somewhat fuller record of hazelnut pests and diseases (though still less than in major hazelnut regions). From “Pests and diseases of hazelnuts in NZ” by Murray Redpath:

- Bacterial blight — *Xanthomonas arboricola* pv. *corylina*
- Hazelnut mosaic (virus disease) — likely Ilarvirus genus such as Apple Mosaic Virus affecting hazelnuts
- Big bud mite (though this is a mite pest, not soil pathogen)
- Hazel leaf miner (mining insect)
- The NZ hazelnut “Pests & Diseases” gallery shows bacterial blight on the trunk as a disease of note in NZ orchards.
- NZ horticultural guides mention “Hazel Blight” (likely bacterial) as the most economically important disease in NZ for hazelnuts, especially on prone varieties and stressed trees, and that copper sprays are used for management.

Bacterial fertilisers & bio-inputs (how they help BBM control)

Goal: Make buds **less attractive** (less soft, less prolonged succulent growth), strengthen plant **defences**, and keep **balanced nutrition**. Bio-inputs don't kill mites; they **shift the plant** out of the high-risk state.

1) Core microbial/biostimulant options

- **Bacillus subtilis / B. amyloliquefaciens** (rhizosphere competence, ISR-priming, N-use efficiency).
- **Pseudomonas fluorescens** (root development, ISR, micronutrient solubilisation).
- **Trichoderma harzianum/atroviride** (root vigor, hormone tuning, stress tolerance).
- **Silicon (potassium silicate)** (foliar or fertigation) to **harden epidermis** and buds; reduces "soft target" attraction.
- **Kelp/seaweed + humic/fulvic** (early season only) to prime roots, then **dial back** before late summer to avoid over-lush growth.

Beneficial Soil Microbes for Biocontrol

Beneficial microbes injected or incorporated into the soil can suppress chestnut pathogens through competition, antibiosis, and induced systemic resistance.

1. *Trichoderma* spp. (e.g., *T. harzianum*, *T. viride*)

- Outcompete pathogens for space/nutrients.
- Produce antifungal enzymes that degrade pathogen hyphae.
- Improve root health and nutrient uptake.

2. *Bacillus subtilis* & *Bacillus amyloliquefaciens*

- Produce antifungal lipopeptides (iturin, fengycin, surfactin).
- Induce systemic resistance in chestnut roots.
- Colonize root surfaces, forming a protective biofilm.

3. *Pseudomonas fluorescens* & *Pseudomonas putida*

- Secrete siderophores that deprive pathogens of iron.
- Release antibiotics and enzymes that suppress *Phytophthora* and *Fusarium*.
- Promote root development and stress tolerance.

4. Mycorrhizal fungi (esp. ectomycorrhizae with chestnuts)

- Enhance nutrient and water uptake.
- Form protective root associations that reduce pathogen entry.
- Improve resilience against drought stress, indirectly reducing *Phytophthora* susceptibility.



MARINE BIOLOGICAL FERTILISER SOIL BIO-ESSENTIALS BLEND

- + 9 BENEFICIAL MICROBES
- + ORGANIC CARBON

- + CONTAINS 9 BENEFICIAL BIO-ACTIVE MICROBES
- + IMPROVES SOIL QUALITY AND STRUCTURE
- + INCREASE NUTRIENT AVAILABILITY AND UPTAKE
- + BUILD THE IMMUNE STRUCTURE WITHIN THE PLANT
- + REDUCE THE IMPACTS OF SALINITY AND DISEASE
- + INCREASES MOISTURE RETENTION CAPACITY
- + SHAKE WELL PRIOR TO APPLICATION

BIOSENTENTIALS is a sustainable, marine-based biological fertiliser designed to restore and enrich soil health. Formulated with nine bio-active probiotic bacteria and fungi, this product works to rejuvenate the soil ecosystem, enhancing its biological activity and overall fertility. The probiotic strains form beneficial biofilm communities around plant roots, fostering a symbiotic relationship that improves nutrient uptake and plant resilience. Bioessentials helps to alleviate the negative effects of soil salinisation, supports mycoremediation of organic soil contaminants, and solubilises inorganic phosphate, making essential nutrients more available to plants. Additionally, the naturally occurring enzymes, siderophores, and antibiotics produced by the probiotic bacteria provide protection against soil-borne pathogens, promoting healthier, more vigorous plants. By improving soil structure and function, Bioessentials lays the foundation for sustained soil health, supporting improved plant growth and vitality.

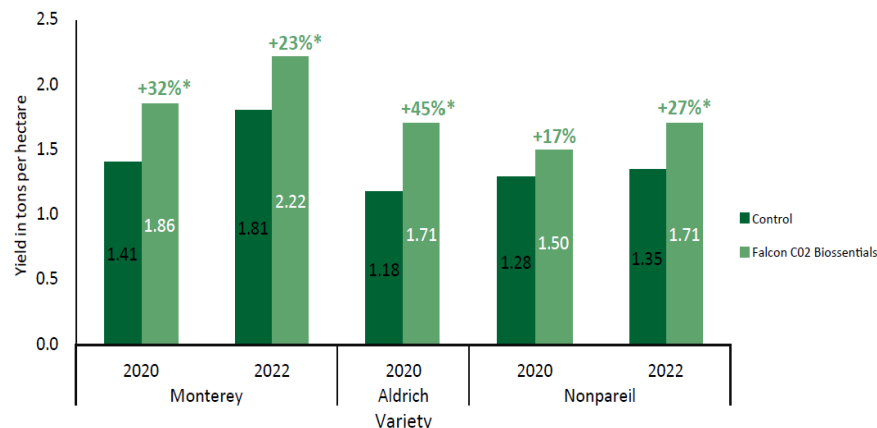
TYPICAL PRODUCT ANALYSIS

TOTAL MAJOR NUTRIENTS	UNIT
NITROGEN (N)	% 1.948
PHOSPHORUS (P)	% 0.033
POTASSIUM (K)	% 9.07
SULPHUR (S)	% 3.06
TOTAL CATIONS	
CALCIUM (CA)	% 1.54
MAGNESIUM (MG)	% 0.58
SODIUM (NA)	% 3.08
TOTAL MINERALS	
COPPER (CU)	PPM 68.43
ZINC (ZN)	PPM 11.3
IRON (FE)	PPM 0.272
MANGANESE (MN)	PPM 66.8
COBALT (CO)	PPM 1.41
MOLYBDENUM (MO)	PPM 0.614
BORON (B)	PPM 21.5
CARBON CONTENT	
ORGANIC MATTER	% 11.1
ORGANIC CARBON	% 32
CARBON/NITROGEN RATIO	C/N 16-18
PH (1:5 WATER)	6.5-7
BENEFICIAL MICROBES	

9P ACTIVE MICROBIAL BLEND (ORGANIC NON-GM PROPRIETARY FORMULA, INCLUDING: BACILLUS SPP., TRICHODERMA SPP., PAECILOMYCES SPP. AND PENICILLIUM SPP.)

PREMIUM BIOLOGICAL FERTILISER

Biossentials increases yield in almonds



* denote statistical difference

APPLICATION RATE RECOMMENDATIONS

STAGE	DOSAGE (L/ha)	APPLICATION	NO. APPLICATIONS	OUTCOME
At planting	1 – 2% dilution	Drench (Bag/Open roots)	1	Improve plant establishment and increase root development
Post planting	1%	Foliar spray 2 weeks post planting. Repeat at 14 day intervals	4 – 6	Improve plant establishment and increase root development
During bloom (30-50% bloom or full bloom)	4 – 7	Foliar spray	1	Increase nut set and crop retention
Petal fall	4 – 7	Foliar spray	1	Increase nut set and crop retention
Fruit set	4 – 7	Foliar spray	1	Improve fruit size and quality parameters
Post-harvest	4 – 7	Foliar spray/Irrigation system	1 – 2	Support the 2nd root flush growth to increase root tip numbers and improve nutrient uptake reserves

PRECISION TARGETING:

Benefit	Outcome
Improved nutrient efficiency	Targeted input saves \$\$ and avoids over-fertilization
Increased yield consistency	Early stress detection allows for timely correction
Reduced disease loss	Better tree health through proactive management
Better ROI	Higher yields and lower costs per kg of nuts produced

5-STEP PRECISION PROGRAM



STEP 1 PLAN

This is essential for aligning our professional services to your requirements that comprises a mixture of activities that take place on site or remotely.



STEP 2 DEPLOY

Drones are deployed as per the flight plan using the camera or payload appropriate for the mission using the right software and survey grid for accurate filming or photography.



STEP 3 REPORT

Here is where the processing and stitching of the images and video footage captured via the drones is processed and converted to data you can use to make informed decisions and take action on.



STEP 4 TREAT

Soil ratios give an indication of the fertility balance in the soil. When the soil is balanced, all elements are available for plant growth.



STEP 5 REPEAT

By referencing the data from previous seasons with the current data captured and comparing results from the same developmental stage from one season to the other, you can obtain insightful data enabling increased yields and lower input costs.

Precision Targeting using Drones, Advanced Testing techniques & Biofertilisers

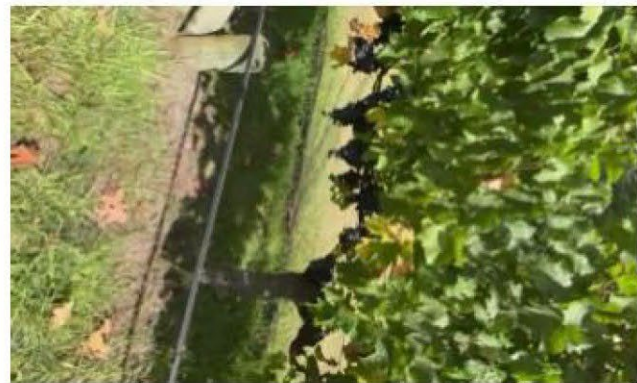
Training AI for Yield Estimation
and Bird Scaring techniques



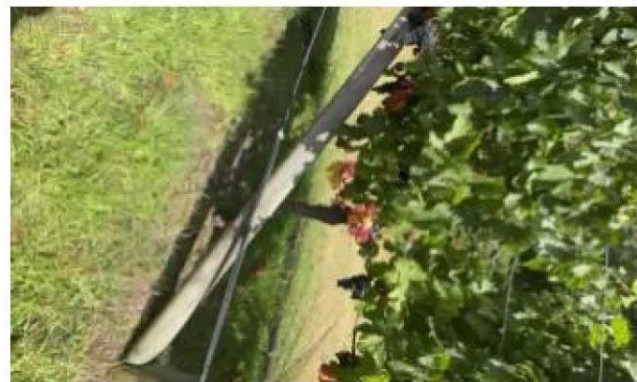
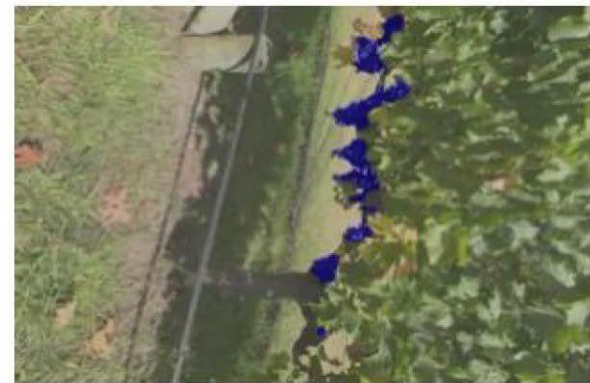
Machine Learning & Training AI: YIELD ESTIMATION



YIELD ESTIMATION



Total Objects	Avg Area	Max, Min, Total Area	Max, Min, Total Weight
7	6218.00	[12326, 582, 43526]	[271, 12, 955]



Total Objects	Avg Area	Max, Min, Total Area	Max, Min, Total Weight
5	4193.00	[10111, 715, 20966]	[222, 15, 458]



Total Frames

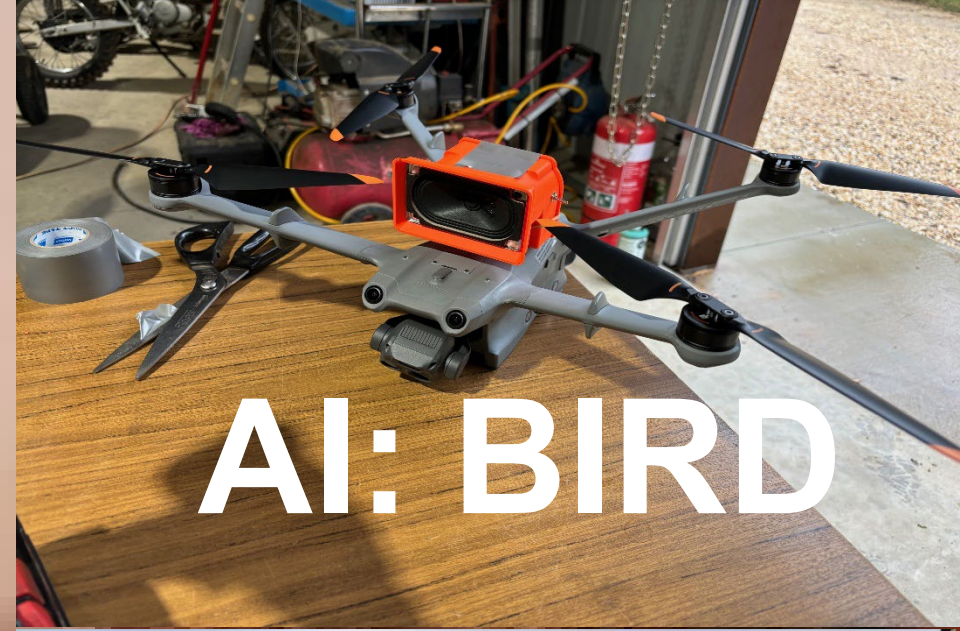
Total Area

Total Weight

36

1,883,687

41,322 grams



AI: BIRD



SCARING



DRONE BASED: BIRD SCARING

10 SHEPPARTON NEWS

THURSDAY, APRIL 10, 202

VIEWPOINT

Drone is something to squawk about



THE GENERAL

I've heard of drones that deliver pizzas, and I've seen them on the telly, picking off Russian soldiers in Ukraine, so there's no shortage of novel ways to use them.

The Boss said there were quite a few on display at the Seymour Expo — some big ones that farmers can use for spraying crops, some medium-sized ones loaded with infra-red cameras that map those parts of a crop stressed from lack of water, or nutrients; and now a smaller one designed to scare off birds.

The last one must have provoked The Boss's interest because he came home talking about it. The cockatoos drive him nuts when they start pruning all the garden trees, not to mention

when they hop into the seeds of his newly-planted crop, so a clever way to send them packing would naturally cheer him up.

There is no shortage of cockies along my river.

The Boss watched Luke Weekley from Falcon UAV demonstrating his drone on the back oval at Seymour, where it quickly evacuated all the birds in the vicinity.

This handy little drone takes off by itself and flies randomly over an orchard, vineyard or rice crop within a pre-programmed area, emitting a cry like a peregrine falcon.

It's designed to take off when flocks of crop-eating birds are around and put the wind up them.

It doesn't need a pilot once it is set up: it lives in its own docking station, along with a weather sensor, so it won't fly if it's too windy or raining. And it charges its own batteries up when it sits back in its dock.

The Falcon drone flies around a crop — apparently

randomly, but broadly covering a grid pattern. It includes waypoints along its path, which can be programmed and changed, where the drone changes its behaviour.

Say there's some tall trees on the edge of a crop where raptors like kites, eagles or falcons commonly perch to get a view. This is a spot the ducks, parrots, galahs and cockies will be watching carefully.

The Falcon drone will pause there and start behaving like a falcon does, emitting a peregrine call in a variety of frequencies so they carry well across the crop.

Luke says they have been trialling the Falcon drone on vineyards, olive groves and walnut plantings with great success.

And they have been particularly pleased how the drone can fool cockatoos, which are the smartest of the birds, often sending out advance parties to scout a crop before the main mob



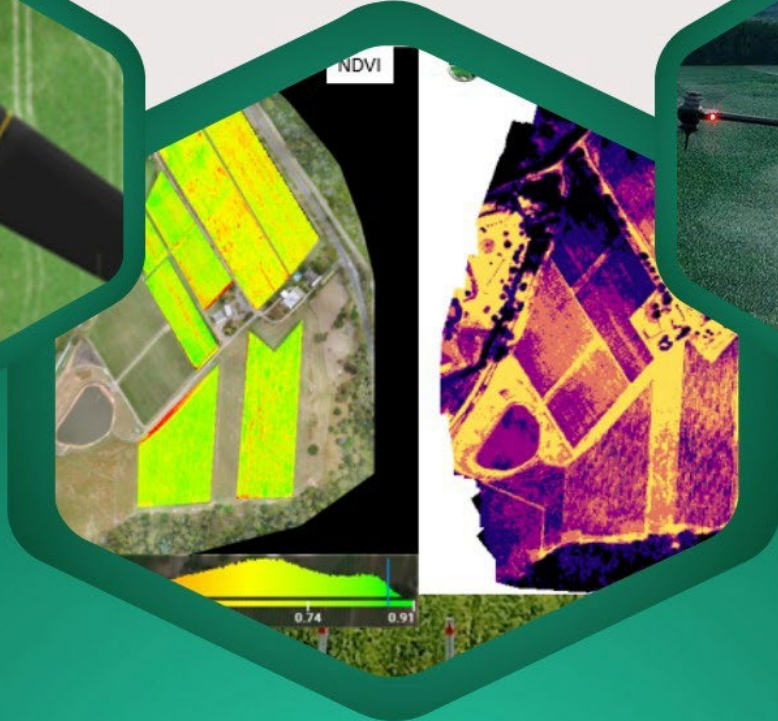
The Falcon drone rises from its dock — all on its own — before heading out to chase away pest birds.

follows.

The Falcon drone hasn't been commercially released

yet but Luke says interested farmers are welcome to register with the company. I'm

waiting for The Boss to get me one. Woof!



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