



Multispectral AI-Enabling Technologies

March 2023



The Company



- ✿ Established by Agrichem (Corteva pesticide distributor), Ira Dvir, and Dr. Nitzan Rabinowitz.
 - ✿ **2 essential patents GRANTED GLOBALLY** (US, Japan, China, EU, Euro-Asia, Canada, Australia, Mexico, etc.) and a **pending US patent**
-

- ❁ **Enabling trustworthy near real-time early detection and identification of pests and diseases.**

Providing **Actionable Data** to growers by:

- ❁ Shifting aerial remote sensing from the **Imprecise NDVI** to **Precise Leaf-Level Multispectral AI**.

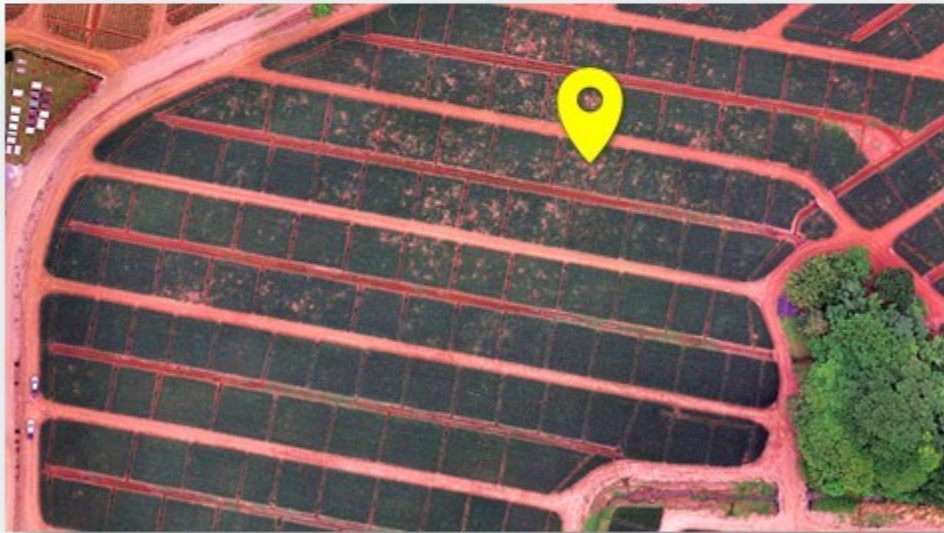
- ❁ Offering **Affordable High-End Multispectral Sensors**.

- ❁ Keeping sustainable advantage through a fast growing and scalable product line.

What do growers need to know for Early-Stage Pests and Diseases Control?



- 🌸 Is there anything wrong in the field?
- 🌸 Where exactly is it?
- 🌸 What exactly is it?



- ❁ **Converting off-the-shelf high-resolution cameras to affordable High-End, Dual-Purpose RGB/Multispectral Sensors of 10 to 14 narrow bands.**
- ❁ **A worldwide patented design, which enables Close-Range multispectral imagery acquisition at Sub-0.5mm per pixel, for Leaf-Level AI.**
- ❁ **2023 scaling to 10 bands of 36MP per band and 6 bands of 72MP per band, using 120/150MP Medium Format Cameras!**
- ❁ **Award winning – CUAV Expo, USA, China Overseas Talents Innovation Competition**

Multispectral imaging apparatus US10574911B2

Disclosing Agrowing's innovative design of utilizing single mount DSLR cameras with multi-lens compound, converting off the shelf DSLRs into high-end multispectral sensors

Method for aerial imagery acquisition and analysis US20190073534A1

Disclosing Agrowing's Remote & Close real-time and near real-time aerial detection and identification of agricultural pests, diseases, stress, and irregularities

Agrowing's uniqueness is founded in a very strong intellectual property, held within the employee base as industrial know-how and as patents embodied in Agrowing's current range of products

Patent	Patent/Appn No.	Country	Status
Multispectral Imaging Apparatus	3308209	Europe/Spain/UK	Granted
	502020000079486	Italy	Granted
	2020/12940	Turkey	Granted
	10,574,911	USA	Granted
	6983663	Japan	Granted
	2016278201	Australia	Granted
	201847001428	India	Pending
	ZL 201680034926.X	China	Granted
	1120170270439	Brazil	Pending
	2988275	Canada	Granted
	10-2017-703565-9	Korea	Pending
	2017-016357	Mexico	Granted
Aerial Imagery Acquisition	201890046	Euroasia	Granted
	10,943,114	USA	Granted
	16,861,733	Europe	Pending
	2018-543475	Japan	Granted
	2016350155	Australia	Granted
	201817019943	India	Pending
	201680071121	China	Granted
	1120180091081	Brazil	Pending
	3,004,388	Canada	Pending
	10-2018-7015897	Korea	Pending
	ZL 2016 8 0071121.2	China	Granted
	2018/005714	Mexico	Granted
201890935	Euroasia	Granted	

Agrowing's Portfolio of HW Products - US 10943114B2 Patent



SONY



2016

QX1/R10C Dual

- 8 Megapixel per band NDVI/Red-Edge lenses 4 40nm narrow bands per lens for APS-C E-Mount



SONY



2020

Alpha 7Rxxx Quad

- 12 Megapixel (A7Riv) per band
- 10 15nm 20nm or 30nm narrow bands for Full-Frame E-Mount



SONY



2021

Alpha 7Rxxx Sextuple

- 8 Megapixel (A7Riv) per band
- 14 Narrow Bands
- 15nm 20nm or 30nm per band for Full-Frame E-Mount



ADTi



2022

ADTi Lightweight* Dual

- 265gr including lens
- Our award-winning 4 band sensor



ADTi



2023

102MP Medium Format

- (coming soon)
- Partnering to provide the best by far multispectral solution in a small package and real-time processing capabilities

SONY



2018

Alpha 6x00 Dual

- 10 Megapixel per band NDVI/Red-Edge lenses 4 40nm narrow bands per lens for APS-C E-Mount

SONY



2020

DJI M600 Accessories

- Combined with Gremysy's Pixy U and T3 V.3 gimbals, Agrowing offers a complete package for DJI's Matrice 100/600 drones

ADTi



2022

ADTi Lightweight*

- 42MP Quad/Sextuple
- 424gr including lens
- Our award-winning 10 band

ADTi



2023

ADTi Lightweight*

- 61MP Quad/Sextuple
- 450gr including lens
- Our award-winning 14 band

- An additional line of multispectral sensors Sony's IMX 411, IMX461, and IMX455 sensor of 61MP, 101MP, and 151MP. Providing **9+RGB of 13MP, 9+RGB of 21MP, and 9+RGB of 32MP per band, and 6 bands of 28MP, 45MP, and 68MP per band sensors**
- Providing top resolutions

Recognition



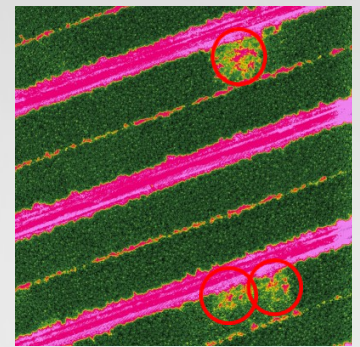
**Jeremiah Karpowicz Editorial
Director of
Commercial UAV News**

INNOVATIVE PRODUCT
PRESS AWARD WINNER
COMMERCIAL
UAV EXPO
AMERICAS | LAS VEGAS
OCT. 28-30, 2019

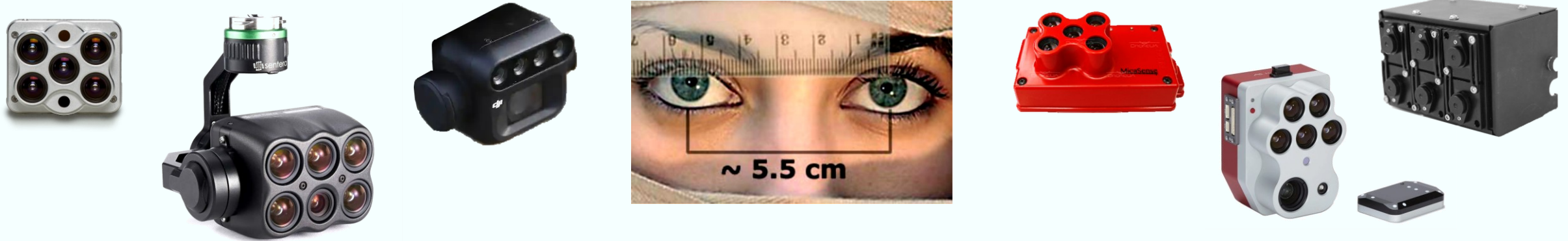
“Agrowing Ltd. has an established track record when it comes to enabling powerful tools for farmers and growers.

The provider of AI-enabling multispectral sensors consistently creates products that set it apart from the competition to enable real opportunities for users.”

Agrowing's Remote and Close Sensing Uncompromised Scanning of the Entire Field



Close Range Parallax



All the multicameras based sensors:
MicaSense; Sentera; DJI; Slanrange; TetraCam
have significant distance
between their bands-acquisition points of view.

The distance can be of 4cm or even 12cm.

Such distance makes it impossible to align the spectral bands of the
vegetation from close range,
preventing leaf-level multispectral imagery acquisition.

Agrowing's Solution for Ground Vehicles



The distance between the lenses in Agrowing's current products is:

Dual (Sony, ADTi APS-C based cameras): **11.8mm**

Quad (Sony, ADTi, Full Frame based cameras): **12mm vertical and 18mm horizontal**

Sextuple (Sony, ADTi, Full Frame based cameras): **12mm**

Agrowing is developing a Quad (10 band/9 band+WideRGB) sensor for ground vehicles and robot in orchards and greenhouses.

The distance between the lenses will be:

6.3mm and 7.25mm using the IMX540 sensor

8.35mm and 12.5mm using the APS-C sensor

Enabling focus and bands alignment: **<75cm to 7m**





MicaSense



PHASE ONE

	AGROWING	MicaSense	sentera	SLANRANGE	PHASE ONE
Bands	●	◐	◐	◐	◐
Dynamic range	●	◐	◐	◐	◐
Resolution	●	◐	◐	◐	◐
Chroma aberration	●	◐	◐	◐	◐
Synchronization	●	◐	◐	◐	◐
SWIR	○	◐	○	○	◐
High resolution RGB	●	◐	◐	◐	◐
Weight	◐	●	◐	◐	◐
Radiometric calibration	●	◐	◐	●	●
Distribution	◐	●	◐	●	●
Price	●	◐	◐	◐	○

Agrowing's Disruptive AI Software



- Our sensors enable superior NDVI analysis
- Our sensors take aerial remote sensing to first order Leaf-Level AI analysis and classification
- Agrowing's software enables automatic detection and identification of pests, diseases, nutrient deficiencies, soil quality, yield prediction, etc.
- Cloud upload is minimized to a small fraction of the data and in many cases even redundant

Agrowing's Automation-Enabling Analysis



Multispectral Leaf-Level Imagery Bank

Of pests, diseases, vegetation irregularities

- Sub-0.5 mm per pixel multispectral data of 10 and 14 bands enables detecting hazards' suspects with extremely high accuracy, avoiding false negative and false positive mistakes
- Multispectral signatures of given phenomena enable separating the hazards from irrelevant similar-colour objects
- Close-ups (RGB/multispectral) are sent to the grower, and if required to the cloud, for final classification

Choose crop

Home > POTATOES > Blight



DSC01724_Sample_x420_y2515



DSC01724_Sample_x1018_y2330



DSC01724_Sample_x968_y1465



DSC01724_Sample_x808_y2343



DSC01724_Sample_x804_y812



DSC01724_Sample_x734_y2913



DSC01724_Sample_x595_y2266



DSC01724_Sample_x572_y2470

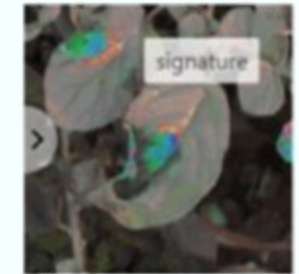


DSC01724_Sample_x559_y2785



DSC01724_Sample_x393_y1089

Phenomenon Multispectral signature ▼



Full resolution source image



Agrowing's Multispectral Signatures



- Agrowing developed a semi-automatic tool for fast creation of customized algorithms, which are suited for distinctive and robust Multispectral Signatures of sampled phenomena, based on a small number of sample.
- The tool enables fast “suspects” detection with minimal false positive and false negative analysis, based on Agrowing’s 10 and 14 spectral bands.

Agrowing Batch Runner

Source folder:

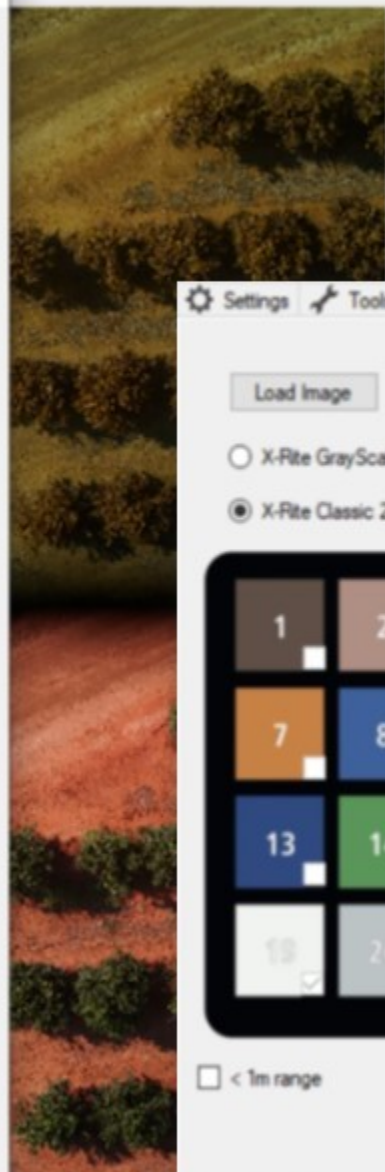
Scan recursive

Batch Settings

APS-C - 4 bands FullFrame - 12 bands

- Save Image Parts
 - Save VIS image Color Adjusted
 - Save VIS image
 - Save NIR image
 - Save (VIS) BG+N (NIR)
 - Save (VIS) RG+N (NIR)
 - Save (VIS) RB+N (NIR)
- Save Color Bands
 - Save 450 nm image
 - Save 550 nm image
 - Save 650/710 nm image
 - Save 850 nm image
 - Save Bands As Multi-Page TIFF
 - Save 4 Bands As One-Page TIFF
- Save Vegetation Indexes
 - Agrowing NDVI Lens
 - Save NDVI image
 - Save GNDVI image
 - Save ENDVI image
 - Save EVI image
 - Save EVI2 image
 - Save ARVI image
 - Save SAVI image
 - Save MSAVI2 image

*Note: GPS data from original image will be saved



Settings

Settings Tools RAW

NDVI Index Color List

[0.51] - [1.00]
[0.41] - [0.50]
[0.31] - [0.40]
[0.21] - [0.30]
[0.11] - [0.20]
[0.01] - [0.10]

Current VI scheme: Agrowing_Enhance

Index range:

Calibration

Show Calibration Image

X-Rite GrayScale Other Panel Type

X-Rite Classic 24

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24

< 1m range NDVI [R=650nm] RedE [R=710nm]

DSC06094.JPG
Model: UMC-R10C
1/640 ,125

Y %
0 93.68

RedEdge lens

calibration (Experimental)

minimization

VIS Image Toolbox

Gamma: 1

0.1 3

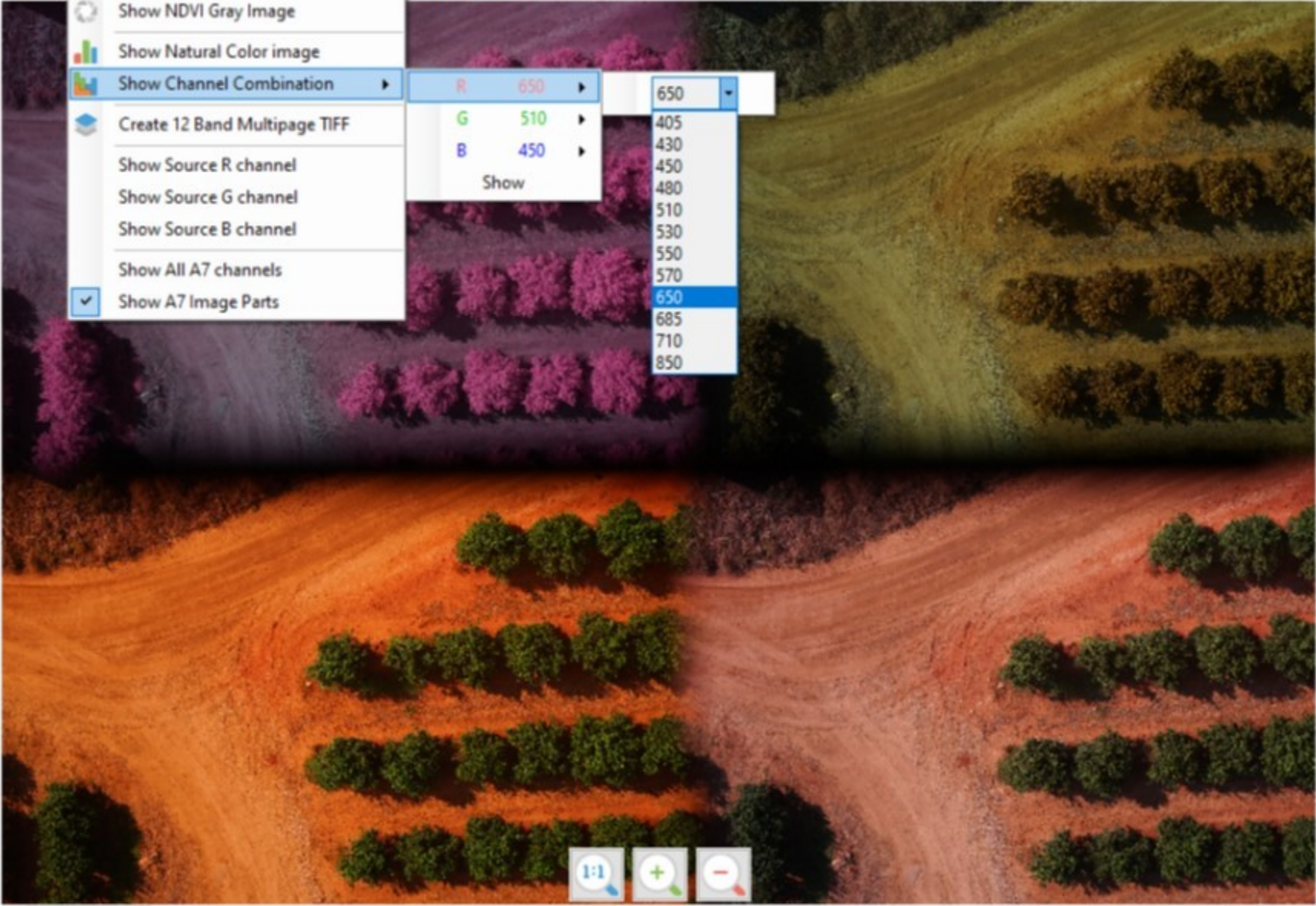
Red channel: 100%

50% 100%

Apply to VI

- Show Image Alignment
- Show NDVI Gray Image
- Show Natural Color image
- Show Channel Combination
- Create 12 Band Multipage TIFF
- Show Source R channel
- Show Source G channel
- Show Source B channel
- Show All A7 channels
- Show A7 Image Parts

R	650	650
G	510	405
B	450	430
		450
		480
		510
		530
		550
		570
		650
		685
		710
		850



Settings Tools RAW

NDVI Index Color List

[0.51] - [1.00]
[0.41] - [0.50]
[0.31] - [0.40]
[0.21] - [0.30]
[0.11] - [0.20]
[0.01] - [0.10]
[-0.09] - [0.00]
[-0.19] - [-0.10]
[-0.29] - [-0.20]
[-0.39] - [-0.30]
[-0.49] - [-0.40]
[-0.59] - [-0.50]
[-0.69] - [-0.60]
[-0.79] - [-0.70]
[-0.89] - [-0.80]
[-0.95] - [-0.90]
[-1.00] - [-0.96]

Current VI scheme: Agrowing_Enhance

Index range: 0.00 - 0.00

Image Alignment: X: 0, Y: 0, %: 93.68

Save Settings... Load Settings...

NDVI lens RedEdge lens

Apply Radiometric Calibration (Experimental)

Correct Relative Illumination

Survey view: 0.00 - 0.00 OFF

Set Survey Background Choose Background...

Survey Total Area: 0%

Palette intensity: 10

Open VI Region By Click: 405-510-850

A7 VI Channels: R/G/B/N - 650-550-450-850

VIS Image Toolbox

Gamma: 1

Red channel: 100%

Apply to VI

650 650

650-550-450-850

- Calculate NDVI
- Calculate ENDVI
- Calculate GNDVI
- Calculate EVI
- Calculate EVI2
- Calculate ARVI
- Calculate SAVI
- Calculate OSAVI
- Calculate MSAVI2
- Calculate RDVI (*)
- Calculate MSR (*)
- Calculate IPVI
- Calculate SIPI (*)
- Calculate SR
- Calculate ISR
- Calculate VARI
- Calculate VIg
- Calculate NDRE
- Calculate SR
- Calculate ISR
- Calculate CI
- Calculate MCARI
- Calculate TCARI
- Calculate TCI
- Calculate TVI
- Calculate PSRI

Red 650
Green 550
Blue 450
Nir(Red2) 850

NDVI Index Color List

[0.51] - [1.00]
[0.41] - [0.50]
[0.31] - [0.40]
[0.21] - [0.30]
[0.11] - [0.20]
[0.01] - [0.10]
[-0.09] - [0.00]
[-0.19] - [-0.10]
[-0.29] - [-0.20]
[-0.39] - [-0.30]
[-0.49] - [-0.40]
[-0.59] - [-0.50]
[-0.69] - [-0.60]
[-0.79] - [-0.70]
[-0.89] - [-0.80]
[-0.95] - [-0.90]
[-1.00] - [-0.96]

Current VI scheme: Agrowing_Enhance

Index range: 0.00 - 0.00

Image Alignment: X: 15, Y: 30, Z: 88.16

Save Settings... Load Settings...

NDVI lens RedEdge lens

Apply Radiometric Calibration (Experimental)

Survey view: 0.00 - 0.00 OFF

Set Survey Background Choose Background...

Survey Total Area: 0%

Palette intensity: 10

Open VI Region By Click 405-510-850

A7 VI Channels: R/G/B/N - 650-550-450-850

VIS Image Toolbox

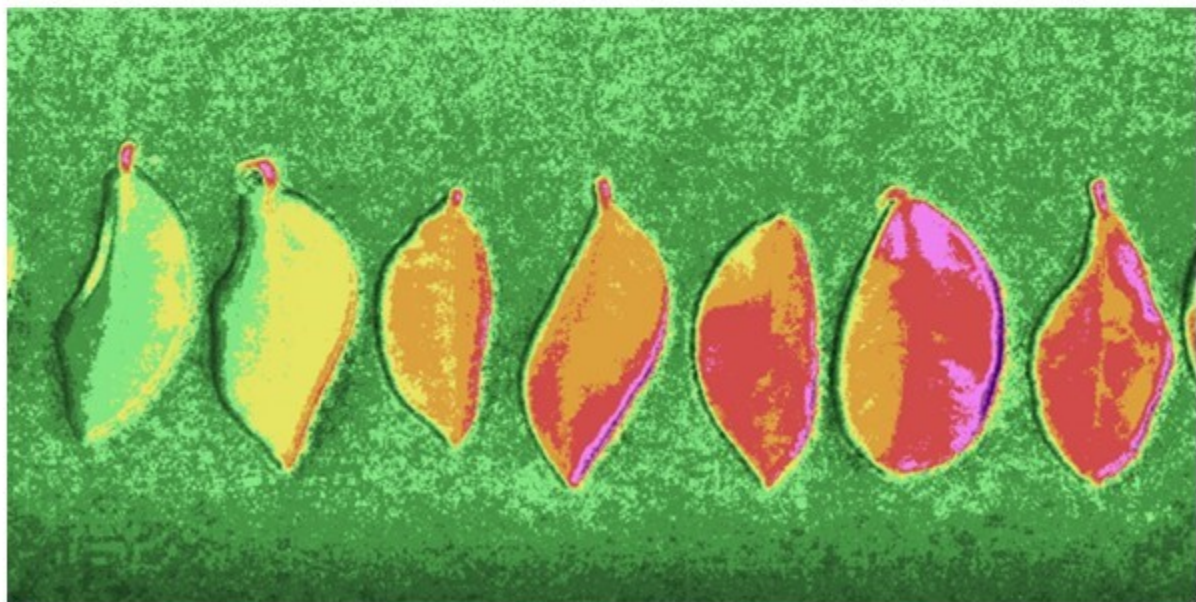
Gamma: 1

Red channel: 100%

Apply to VI

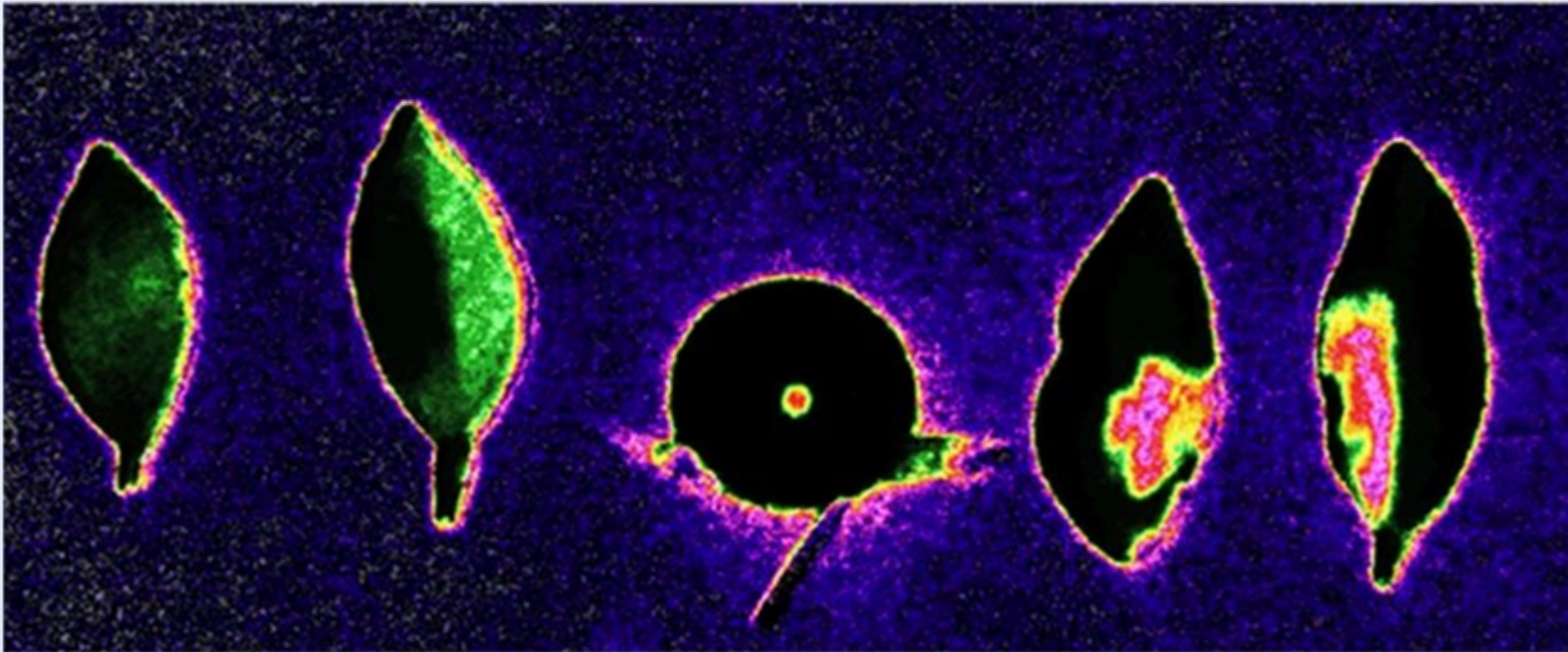


The Proof is in
the Eating of the Pudding!





A VetorGeo (Brasil) and UNESP project



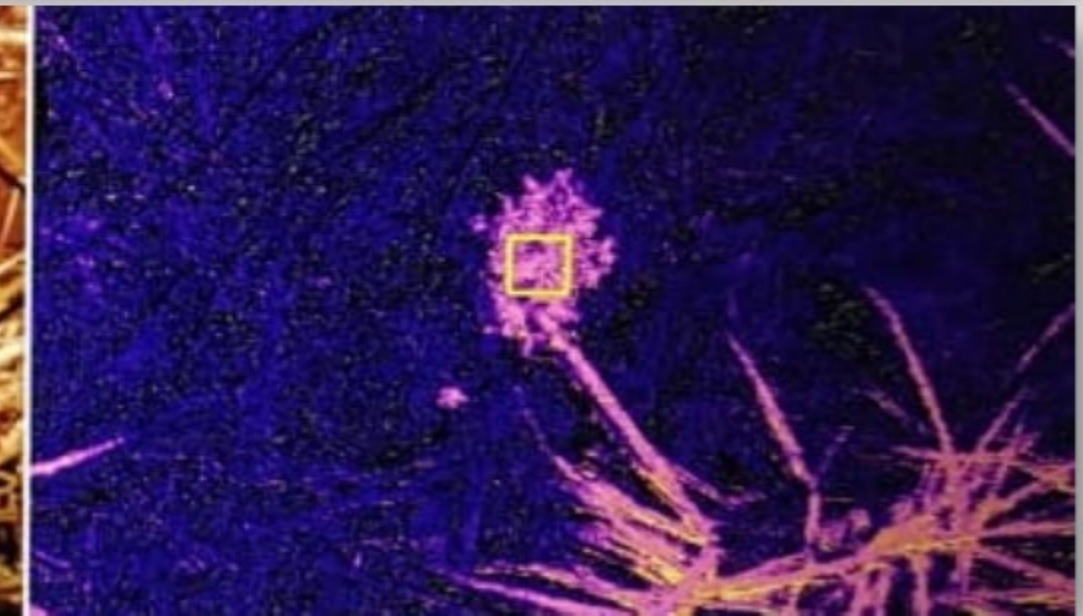
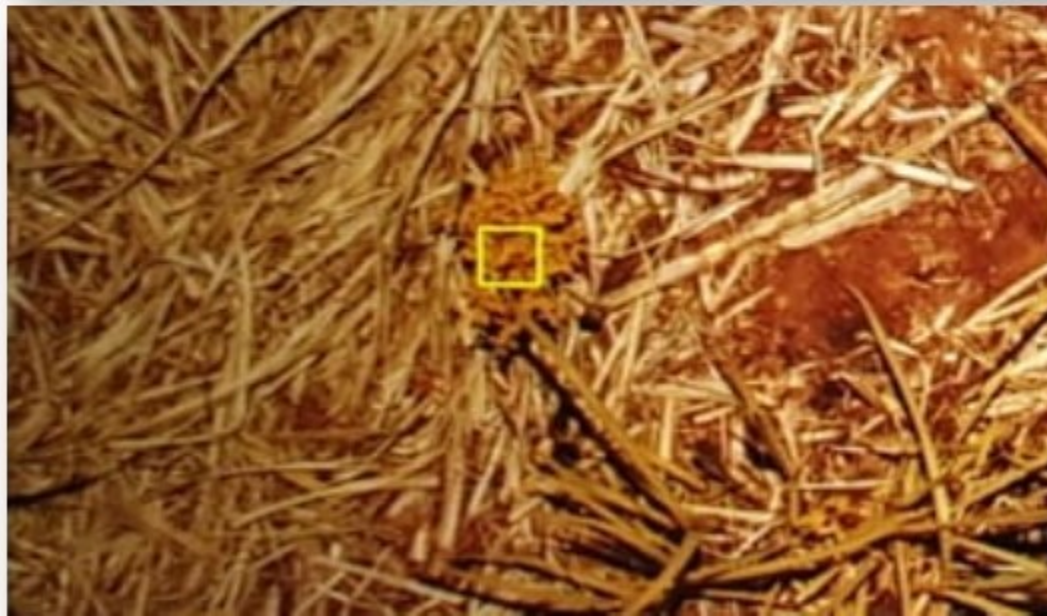
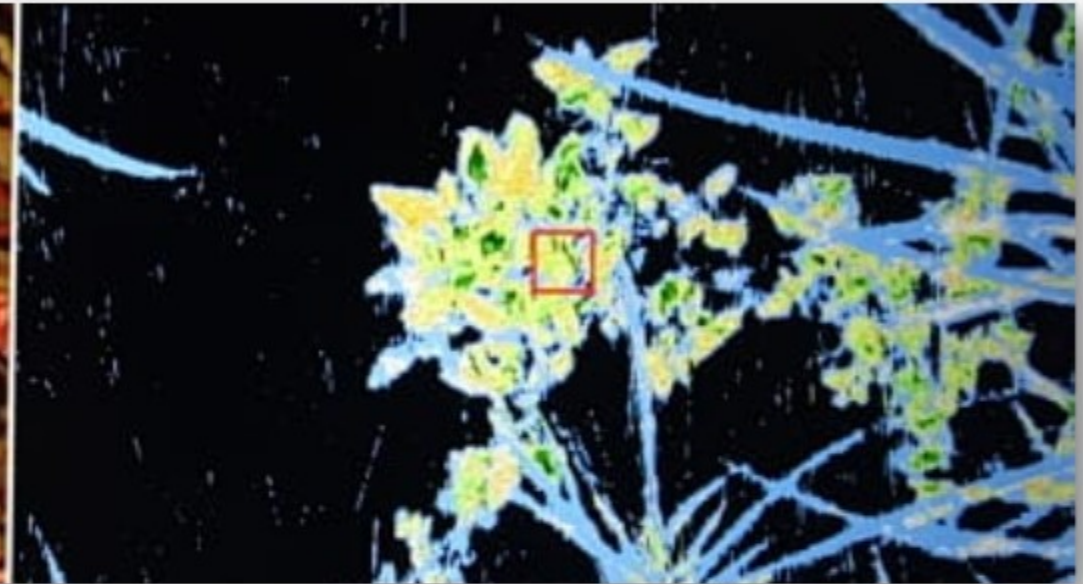


counting oranges in the trees

Samples of WEEDS detection in Sugar Cane



A VetorGeo (Brasil) and Bayer project



Partners and Customers



