DLG TECHNIKERTAGUNG

A state of the art of field high throughput phenotyping – What options do you have?

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AUTHOR(S)

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Discover the fascinating world of plant phenotyping with me

Hiphen Identity Card

Alexis COMAR, PhD
Founder and CEO

DEGREE:

PhD in Plant Phenotyping

TECHNICAL BACKGROUND:

Research project focused on the interaction between the leaves and the light and its consequences for remote sensing applications

IN CHARGE OF:

Company Development & Strategy

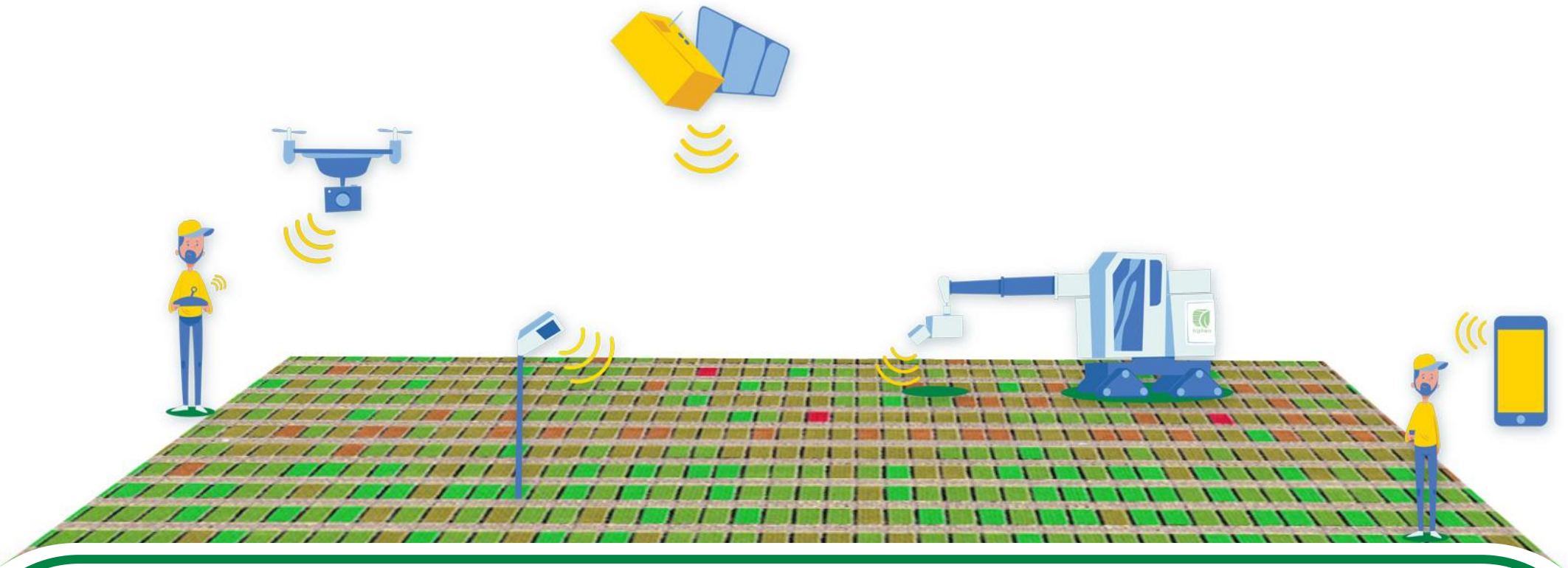
PROUD HIPHENER SINCE:

The beginning of the journey back in 2014

HOBBIES:

Bicycle, Culture lover, Gastronomy

We transform agricultural images acquired from all types of devices into valuable agronomic traits



Mechanistic crop knowledge

Automated data processing

Cloud-based data engine built for scale

Artificial intelligence

Decision making

We are a team of Agtech experts focused on delivering excellence

Alexis COMAR, PhD
Founder and CEO

Rafael BENICIO
COO

Joss GILLET
CTO

Jérémy LABROSSE
Agtech Engineering and R&D Director

Alexandra BÜRGY, PhD
R&D Project Manager

Bruno MALNAR, PhD
Business Development Lead

Lee WEST
Business Development Lead

Discover more about our solutions with the catalogs

PhenoScale by hiphen

Professional High-Throughput Plant Phenotyping From **Drones**

RGB – Multispectral

Discover Now

PhenoStation by hiphen

Custom-made Plant Phenotyping Systems For Greenhouses

Discover Now

PhenoMobile by hiphen

Ground-based Plant Phenotyping Solutions To Scale Up **Advanced Plant Characteristics Assessment**

Discover Now

PhenoResearch by hiphen

Custom R&D Solutions To Develop Your Own **Plant Phenotyping Remote Sensing Applications**

Discover Now

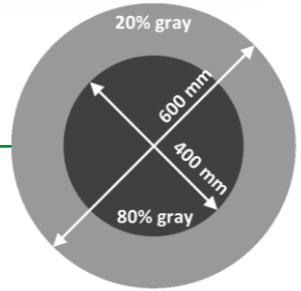
PhenoScale: Scale up your crop assessment in a hassle-free fashion with drones

Drone Device & Sensor(s)

PhenoScale by hiphen

Acquisition Equipment & SOPs

GCP target



RTK GPS

Standard Flight Procedure document (provided by Hiphen)

Off-The-Shelf Agronomic Traits

PhenoMobile: High-resolution plant assessments

PhenoMobile by hiphen

And more...

(...)

- Processing Orchestration
- API Integrations
- Data Traceability
- User Interface (UI)

1 Motorized Structure (Vehicle)

2 Measurement Head With Sensors

3 Data Processing

Option 1: You delegate it all to Hiphen and benefit from our full ground-based plant phenotyping expertise (1+2+3)

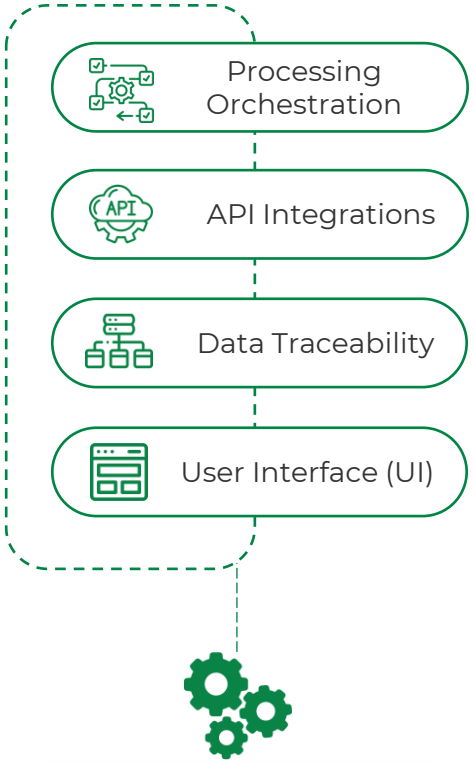
Option 2: You use your own vehicle and mount the measurement head + data processing (1+2)

Option 3: Data processing only (1)

PhenoStation: The plant phenotyping systems that adapts to your facility & greenhouse conditions

PhenoStation by hiphen

Complete End-to-end Solution with Hiphen Intelligence that includes **Mechanical Engineering, Sensor Array & Processing Unit**



Structure & Mechanical Engineering + **Sensor Array** + **Data Processing Unit**

PhenoResearch: Our R&D solution to develop your own applications

PhenoResearch by hiphen

Today

Audit

Go / No Go

Pilot Phase

Go / No Go

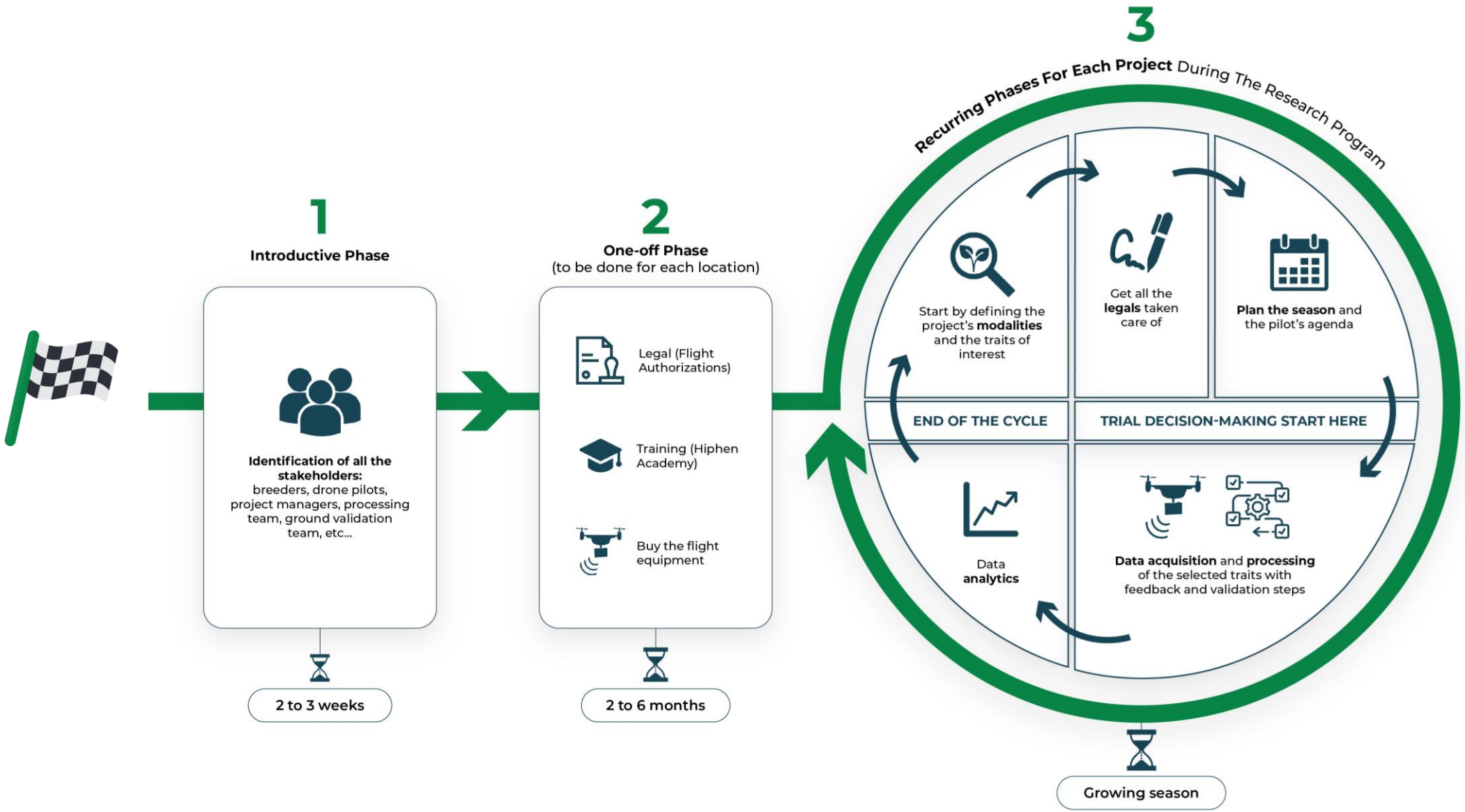
Deployment Phase

We meet to **de-risk** and **specify** the project

- Data Acquisition Protocol
- Data Processing
- Validation & Analytics
- Conclusion Workshop

We adapt our data pipeline to be **triggered upon demand** for the next campaign depending on the conclusions of the development phase

Plant phenotyping solutions are easy to implement into your research program



A hassle free, project based experience

You

Data upload

You take care of the data acquisition, and you upload your raw images, plot file, and GCP file in Cloverfield

Hiphen

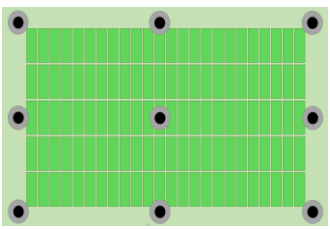
Quality assurance

We automatically evaluate data quality and that the requested data acquisition procedure was used

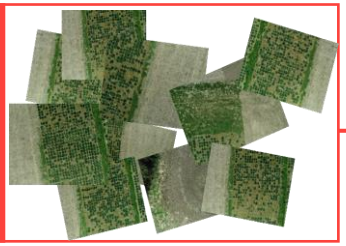
In case of quality issue, we provide immediate feedback to mitigate it

Data processing starts

Detect GCP



Stitch images

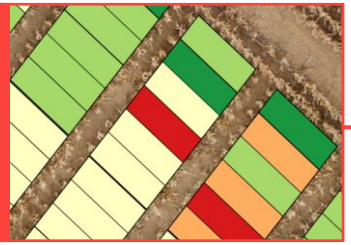


Produce a geo-referenced orthomosaic

Create a plot map

Extract best raw image for each microplot

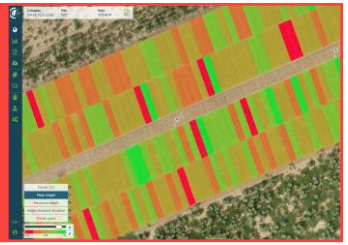
Compute traits



Validate results

We validate results using an automated stats check and a human check on a random data selection.

Publish results to Cloverfield



Data download

You visualize, analyze and download your field trial results from Cloverfield to inform your analytics

Access your traits in Cloverfield, our web interface to visualize plant phenotyping data

Easily drag and drop your datasets

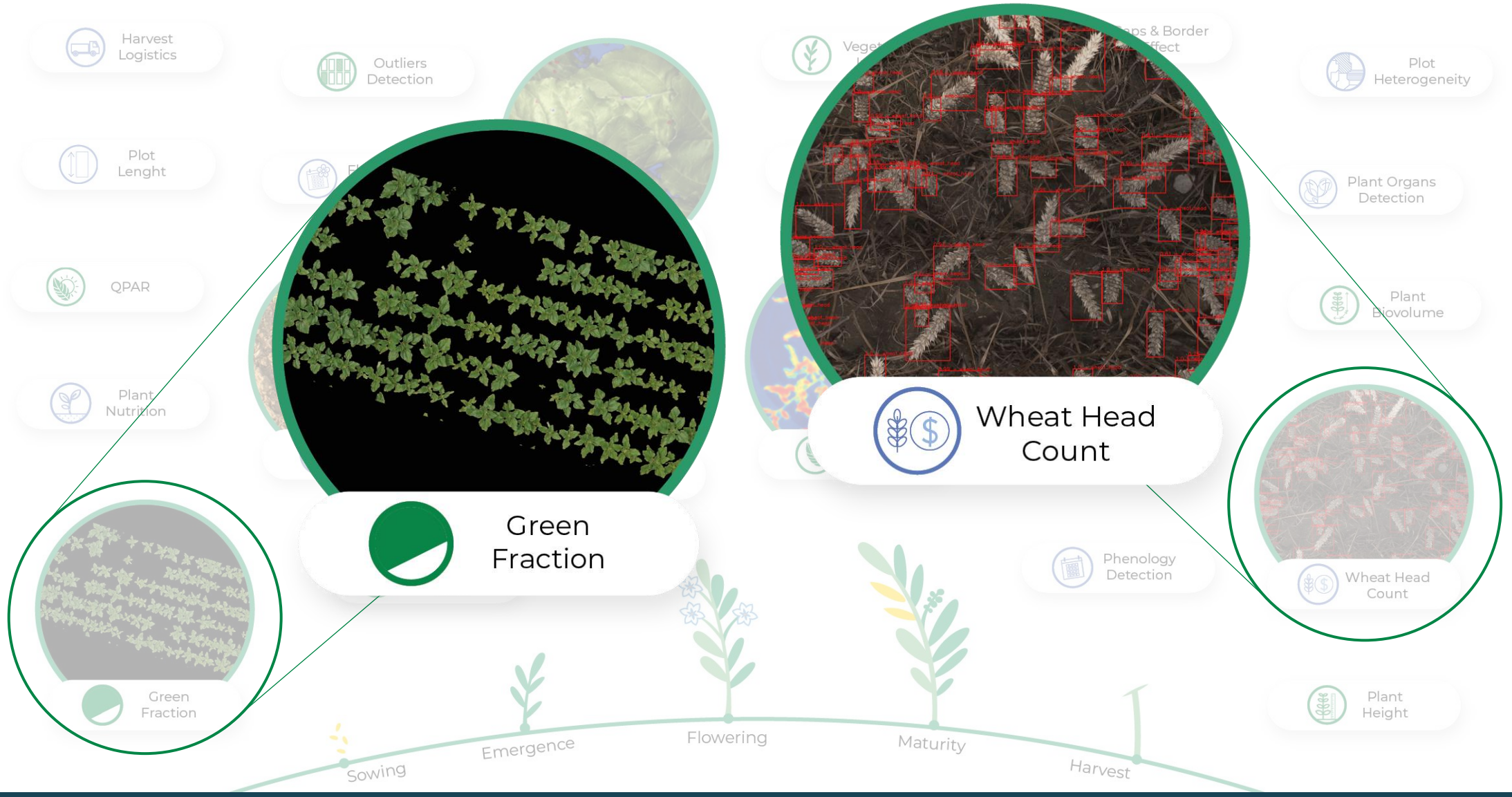
All your sites accessible in one place

All your traits only a click away

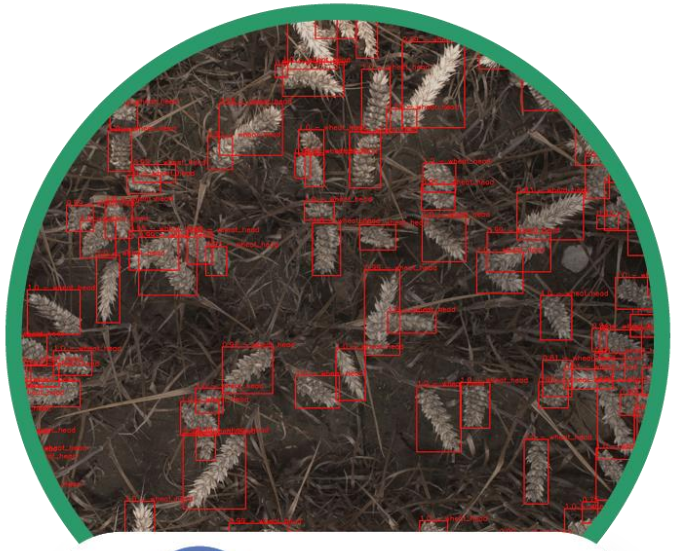
Inspect your microplots and analyze trends through time

Download your results in one click

How to measure phenotyping traits? An example with Green Fraction & Wheat Head Count



Assessing Wheat Head Count



Wheat Head Count

What is Wheat Head Count?

Wheat head count is one of the **inputs** used to **predict yield** but is still largely collected manually nowadays. At Hiphen we offer the possibility to **automate and scale** these measures using **Deep Learning** algorithms.

Method:

Machine Learning Only

Sensor:

RGB

Devices:

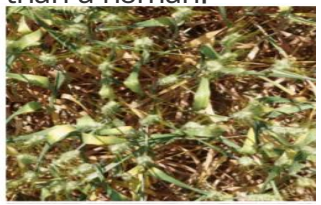
Entry-level drone

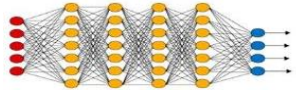
High resolution drone

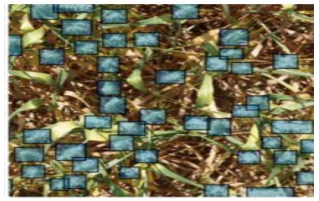
PhenoMobile

*Yes, but challenging

Deep Learning is the only way to count wheat heads with the same level of accuracy than a human:





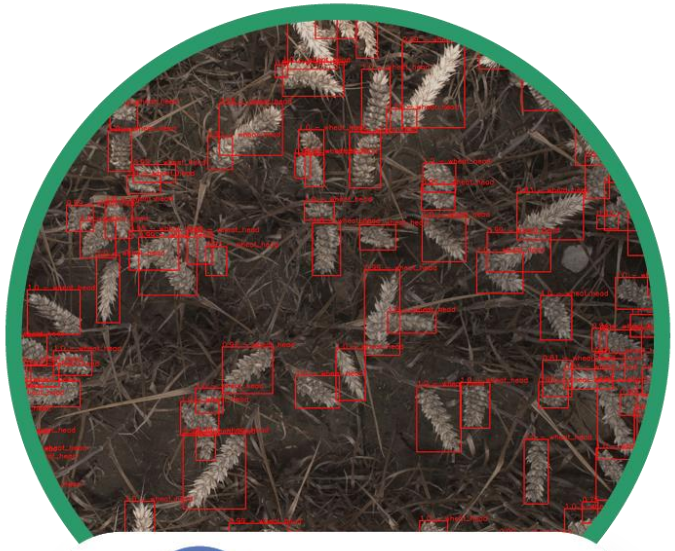


Global WHEAT Dataset

- **6 515 images**
- **280 000 labelled wheat heads**

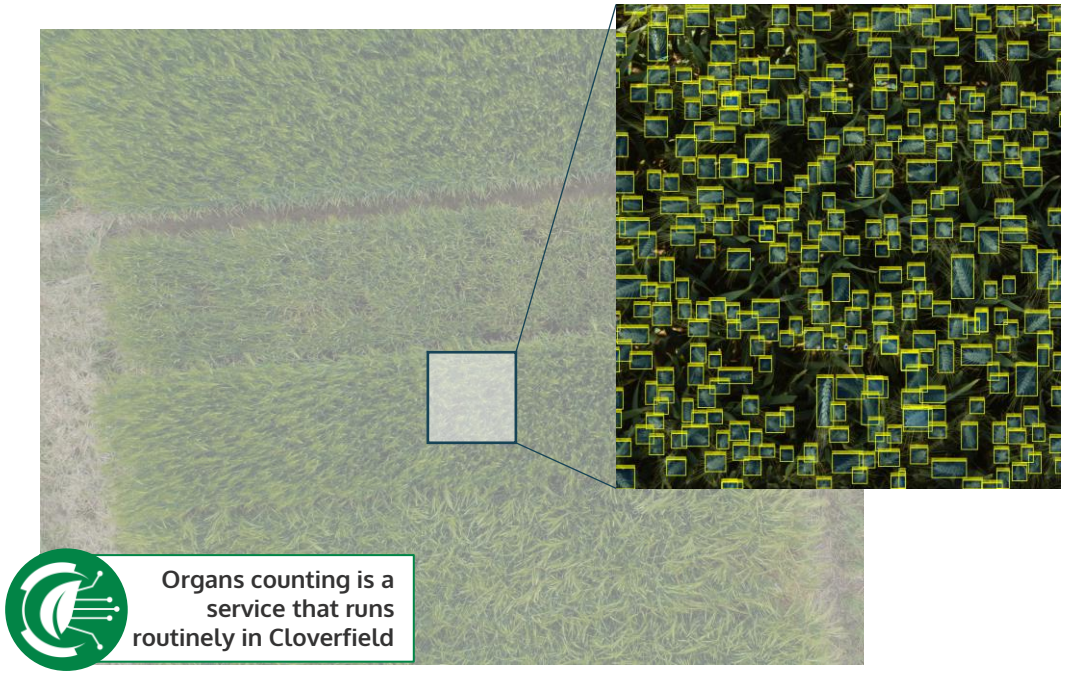
- **2 campaigns** (2020 & 2021)
- **16 institutions** involved
- **12 countries & 3 continents**
- **1 huge & diverse dataset created**
- **Hiphen supported this initiative**

Wheat Head Count: how it works?

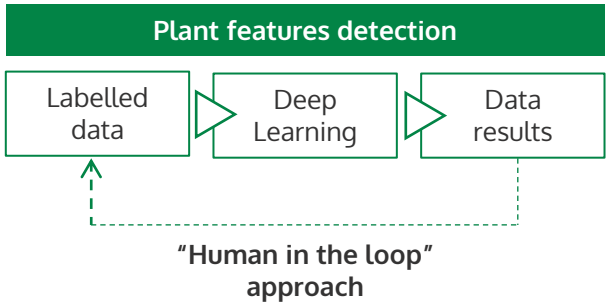


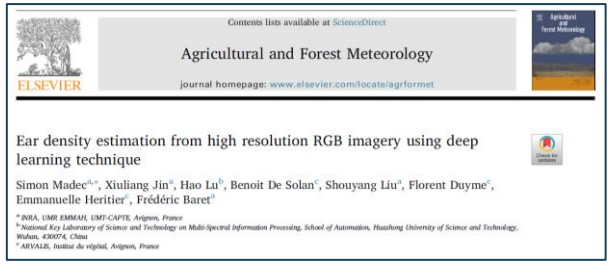
How to compute Wheat Head Count?

Wheat Head Count being a **complex trait** to assess, we have built a **robust methodology** to detect plant organs precisely from several devices such as drones and PhenoMobiles.

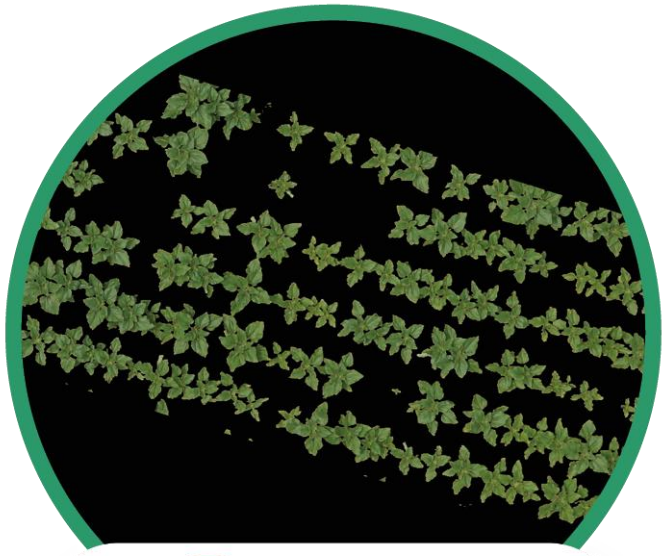


Deep Learning is changing the game by allowing your experts to easily finetune the model





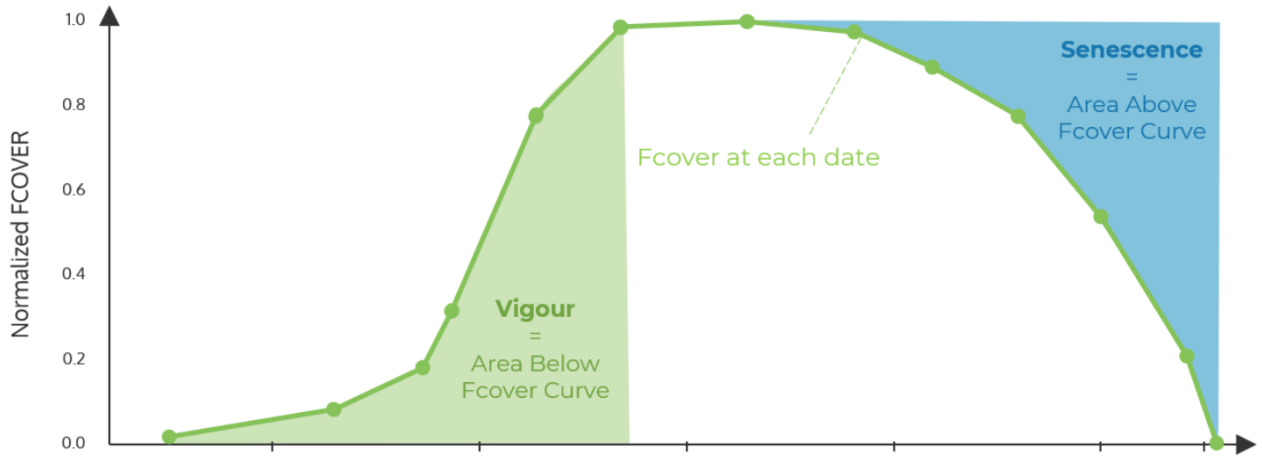
Assessing Green Fraction



Green Fraction

What is Green Fraction?

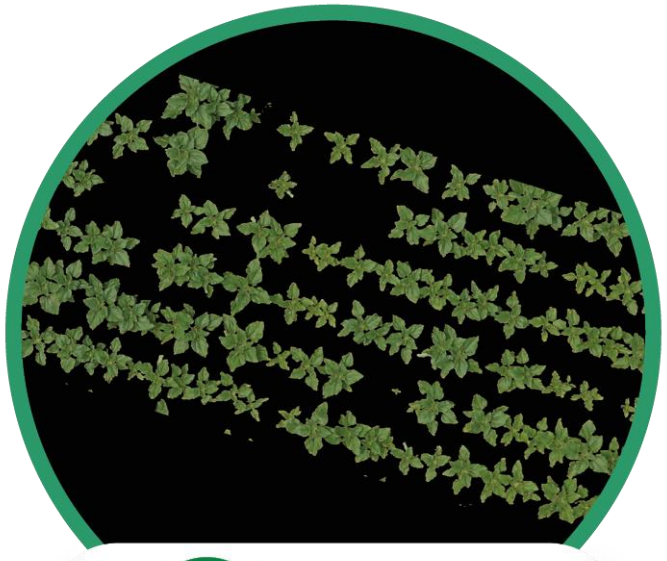
The Green Fraction of Vegetation Cover or **Fcover** as we like to call it at Hiphen, refers to the **percentage of green vegetation** within a plot. This trait is computed routinely at Hiphen.



Green Fraction helps you to assess the **plant growth development** throughout the entire crop cycle. It is also used to **calculate traits derived from Green Fraction**:

- **Leaf Area Index**
- **QPAR**
- **Stay Green**
- **And more…**

Green Fraction: various computing methods



Green Fraction

How to compute Fcover?

As we said before, the traits you are interested in must drive the device(s) and sensors selection. Thus, we have built **robust methods to compute Fcover** using several techniques and devices.

	Vegetation Indices	Image Segmentation	PROSAIL Inversion
	NDVI, VARI	Including Machine Learning & Deep Learning techniques.	PROSAIL radiative transfer model
	✓	✗	✓
 RGB  Multispectra 	✓	✓	✓
 RGB  Multispectra 	✓		✓

Adding environment data to the actual plant data

Phenotype = Genotype x **Environment**

Adding climate and soil data to the actual plant data allows us to derive agroclimatic traits

What Are Agroclimatic Traits?

Biophysical Traits:

- Green Fraction
- Leaf Rolling
- Greeness
- And more

Climate Data:

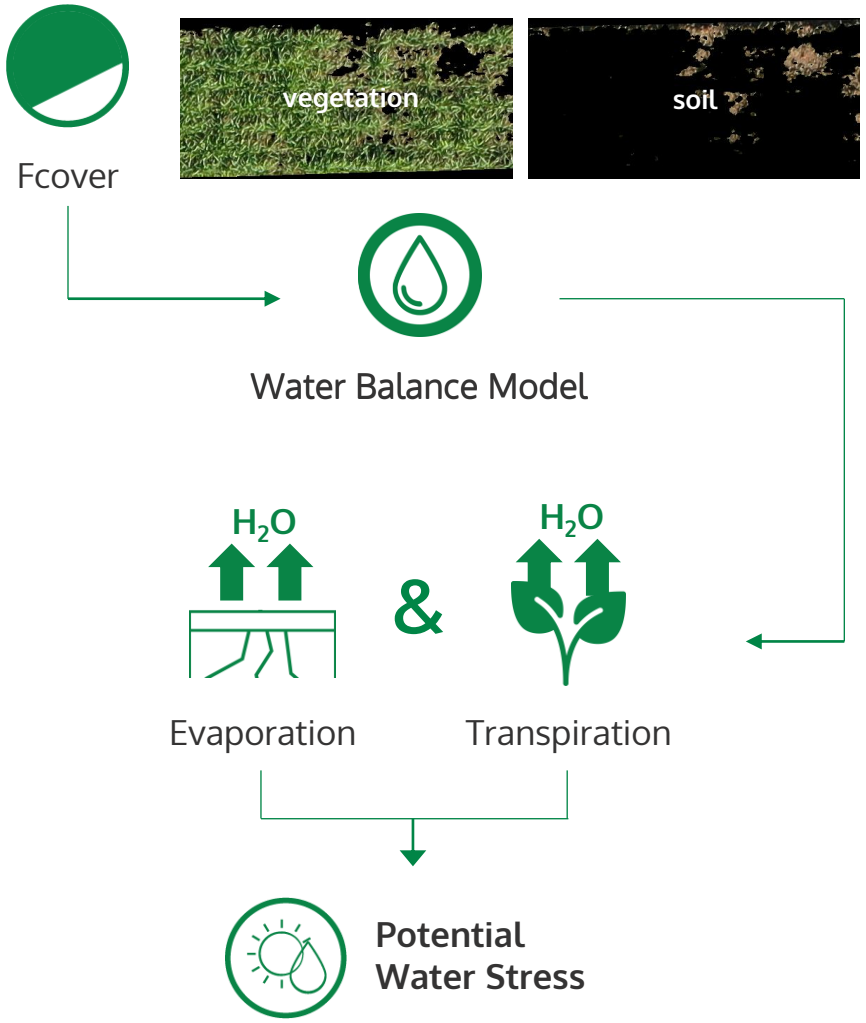
- PAR
- Humidity
- T°
- Wind

Soil Data:

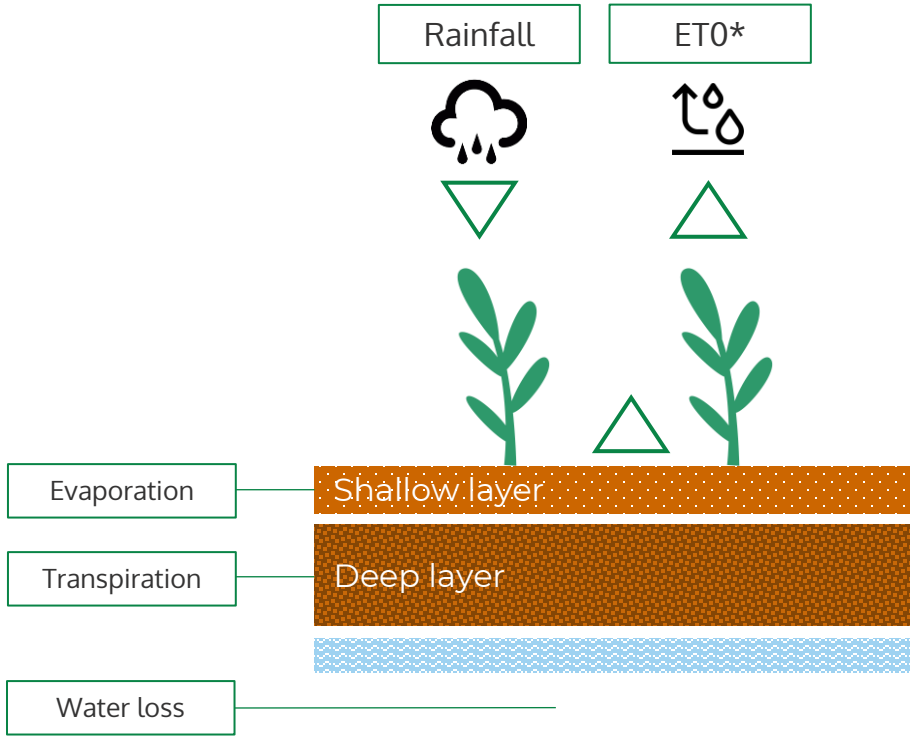
- Water usability
- Wilt point
- And more...

An example with water stress assessment

Evapotranspiration assessment (ETR)

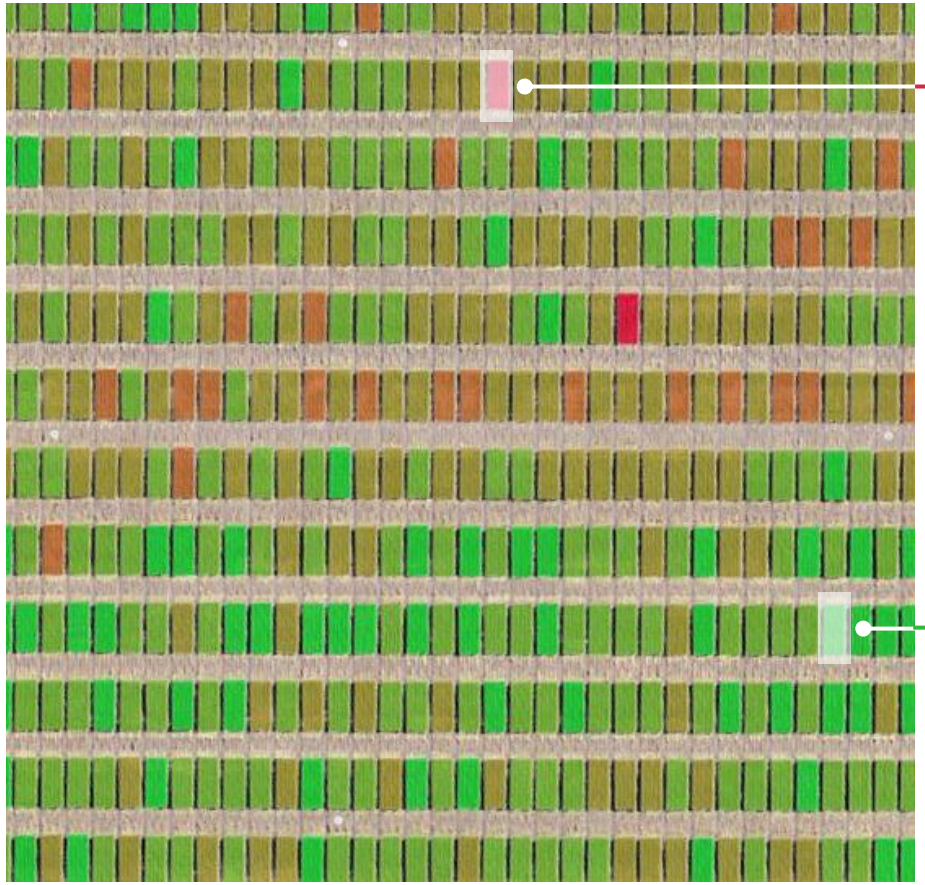


The simplified plant's water balance model



** ET0: reference evapotranspiration*

Using the water balance model to evaluate water stress discrepancies between plots

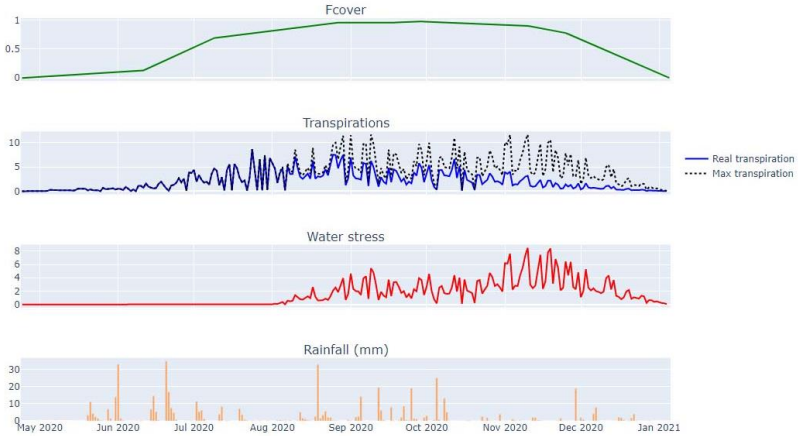


High water stress

Low to no water stress

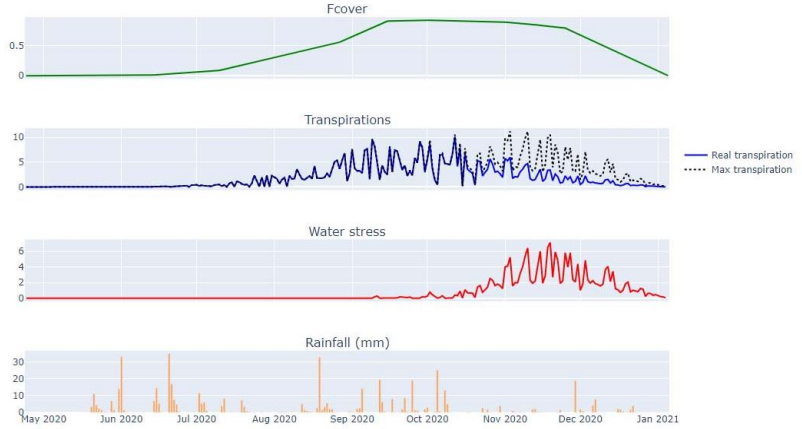
Plot with an **important** transpiration rate

This specific plot had an **early water stress** that influenced the rest of the plants' development



Plot with a **normal to low** transpiration rate

This plot **started to transpire later** so it has made a better use of the water available



Is high-throughput plant phenotyping a scientific whim or a tool to leverage real value?

Research topics to answer academic questions

Real use case to help you save money

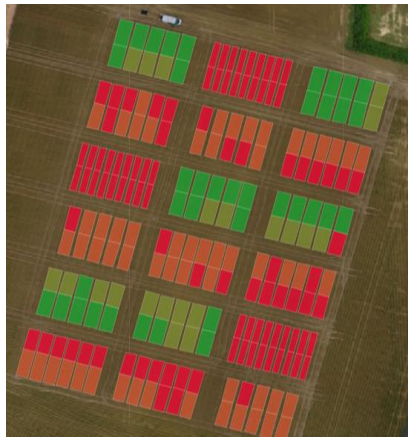
At Hiphen we have identified 5 main applications for plant phenotyping

1

Quality assessment

2

Product performance evaluation

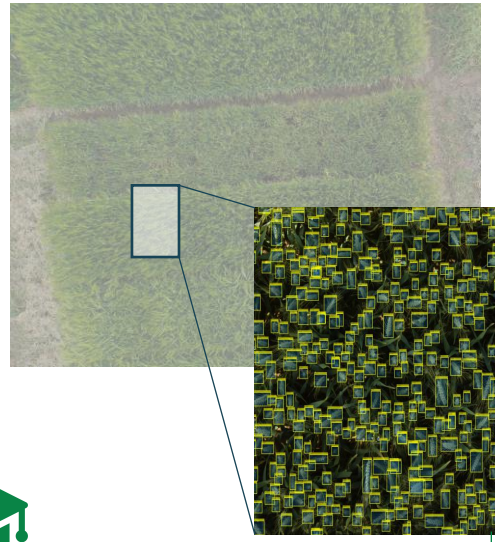


3

Genomic selection

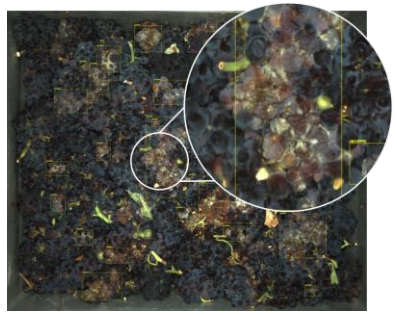
4

Yield prediction



5

Harvest attributes



Business case yet to be proven

Introducing the Hiphen User Club

hiphen Academy

The 1st **e-Learning** platform dedicated to help crop researchers **acquire research-grade** plant phenotyping images from drones

- 6 courses and 45 lessons
- 8+ hours of training
- Based on real-life experience

hiphen User Club

hiphen Science Department

Access to **exclusive collaborations** and scientific **papers** from our Science Department to discover one-of-a-kind use cases and applications

And more premium content

Dedicated **events & webinars** and more premium content is at your fingertips within the Hiphen User Club

Getting started with digital plant phenotyping

1

Select the traits and outputs you are interested in

2

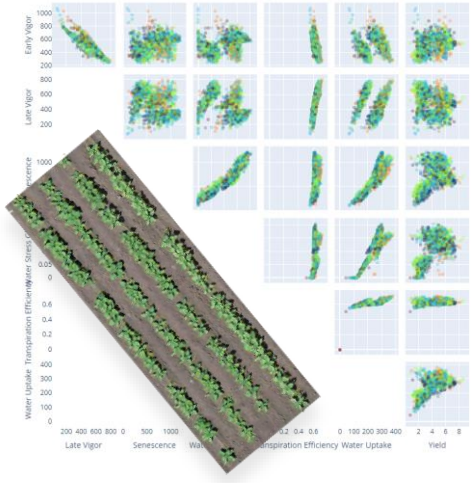
We advise you the best device(s) to choose for the job

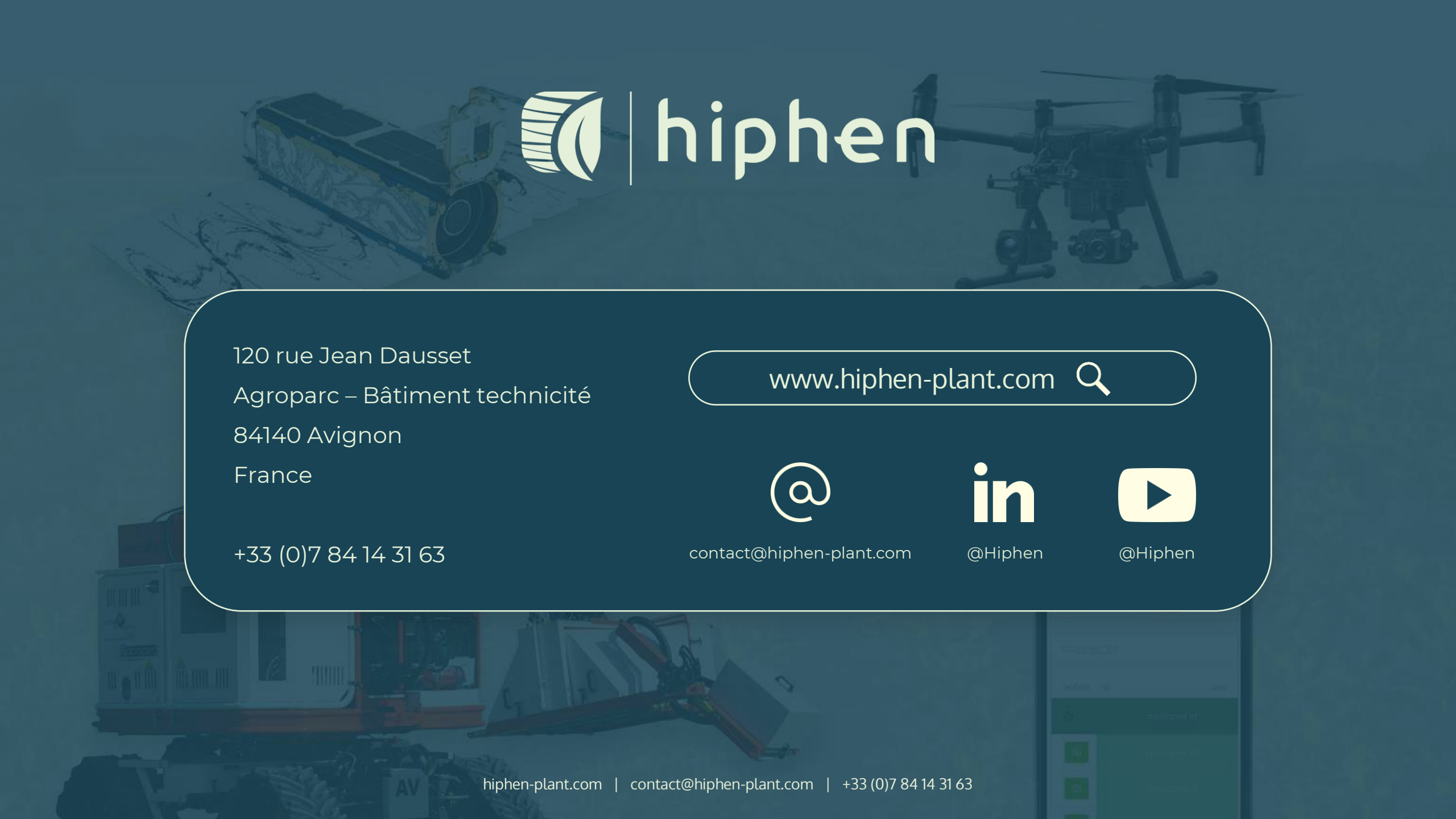
3

You or a third party acquire the data following our guidelines

4

You get your traits' results & analytics





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