SUSTAINABLE CROP MANAGEMENT

www.biobestgroup.com

data-driven precision IPM in greenhouse crops

from vision to execution

Karel Bolckmans

ABIM 2021

October 18th-20th

Patterns in Greenhouse Production

- High concentration of **buying power** in a small number of retailers.
- Shorter value chains ("cut out the middle man")
- Retailers want to deal with as **few suppliers** as possible:
  1. Entire category
  2. All-year-round
  3. Always entire volume (reliability)
  4. Top quality: (1) cosmetic quality, (2) taste, (3) residue poor/free, (4) carbon neutral
  5. Best price
- Fewer but larger, multisite growers
  - Change of ownership structure
  - Increasing complexity and risk → **data-driven growing**
- Labour shortage, quality and cost → **robotization**

} "*The Autonomous Greenhouse*"

- Carbon footprint + Energy cost → Δ climate management (e.g. closed greenhouse, vertical agriculture, …)

Data Is Transforming How Growers Operate

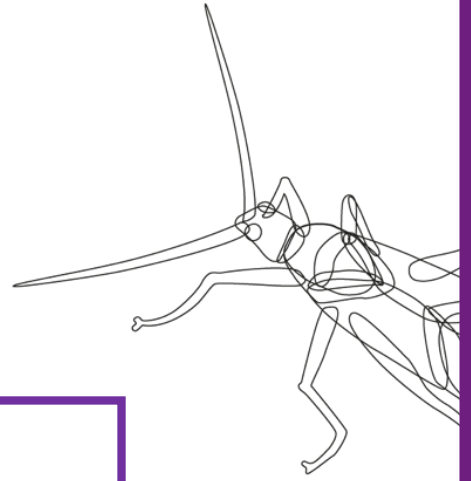
The grower's challenge: **continuously steering** the plants for maximum production through dynamic **climate management** (T, RH, [CO_2], light), **fertigation management** (irrigation, pH, EC, fertiliser mix, …) and **crop management** (leaf picking, lowering plants, cluster pruning, …) and all the **interactions** between them, while keeping **energy cost** and **labor cost** under control → very complex interactions ⇒ **top sport !!!**

Today	❖ Visual inspection. ❖ Grower's experience. ❖ Input from a trusted advisor, such as a sales rep, who has access to otherwise inaccessible information and knowledge. ❖ Supplier product information.
In the (very) near future	❑ **Data-enabled decision making** based on: ✓ real-time data collection (sensors, camera's, computer vision, digitization, IoT, drones, autonomous vehicles, …), ✓ advanced data analytics, artificial intelligence, algorithms (descriptive, diagnostic, predictive and prescriptive analytics), ✓ sharing of best practices via digital farming applications and platforms. ❑ **Automated execution** of farm tasks → robotization

Source: adapted from BCG analysis

Providing Technical Advice

Challenges & Opportunities



Data Collection & Recording

Detecting – Identifying – Quantifying – Mapping

1. Scouting labour
2. Timely detection
3. Data quality

Decision Support

Analysing - Learning - Deciding

1. Access to greenhouses:
   - ✓ PepMV, ToBrRFV,
   - ✓ Covid-19
   - ✓ remote areas
2. Confidence & Decision quality
3. Training new technicians
4. Efficiency

Action

Applying – Recording

1. Application labour
2. Spot treatments

biobest SUSTAINABLE CROP MANAGEMENT

Data-driven Precision IPM
WHAT ?

1. **Data collection & recording** (identity, location, severity of pest & beneficials)
   1) Human eye (Crop Scanner (Agritask), Ecoation-OKO)
   2) Sensors and Camera's (RGB, thermal, hyper-spectral)
      a) Direct observation of pests (PATS)
      b) Indirect observation (plant stress) (Ecoation–Plant Health Sensor) → 2-step approach
      c) Traps (TrapScanner)
   3) High-resolution climate sensors (T, RH, [CO2], light intensity, …)

ecoation

biobest SUSTAINABLE CROP MANAGEMENT

Data-collection and Recording

Digital

Digital Capture of human observation + environmental data per sqm

Immersive

Digital Package + IPM Risk map +full canopy microclimate and 360 8K Virtual Walk

Closed-Loop IPM

Risk projection, digital scouting/treatment, record-keeping, and real-time live alerts.

Yield Production Assessment

Fruit count, color assessment, historical yield trends, and harvest projections.

Crop Work Check

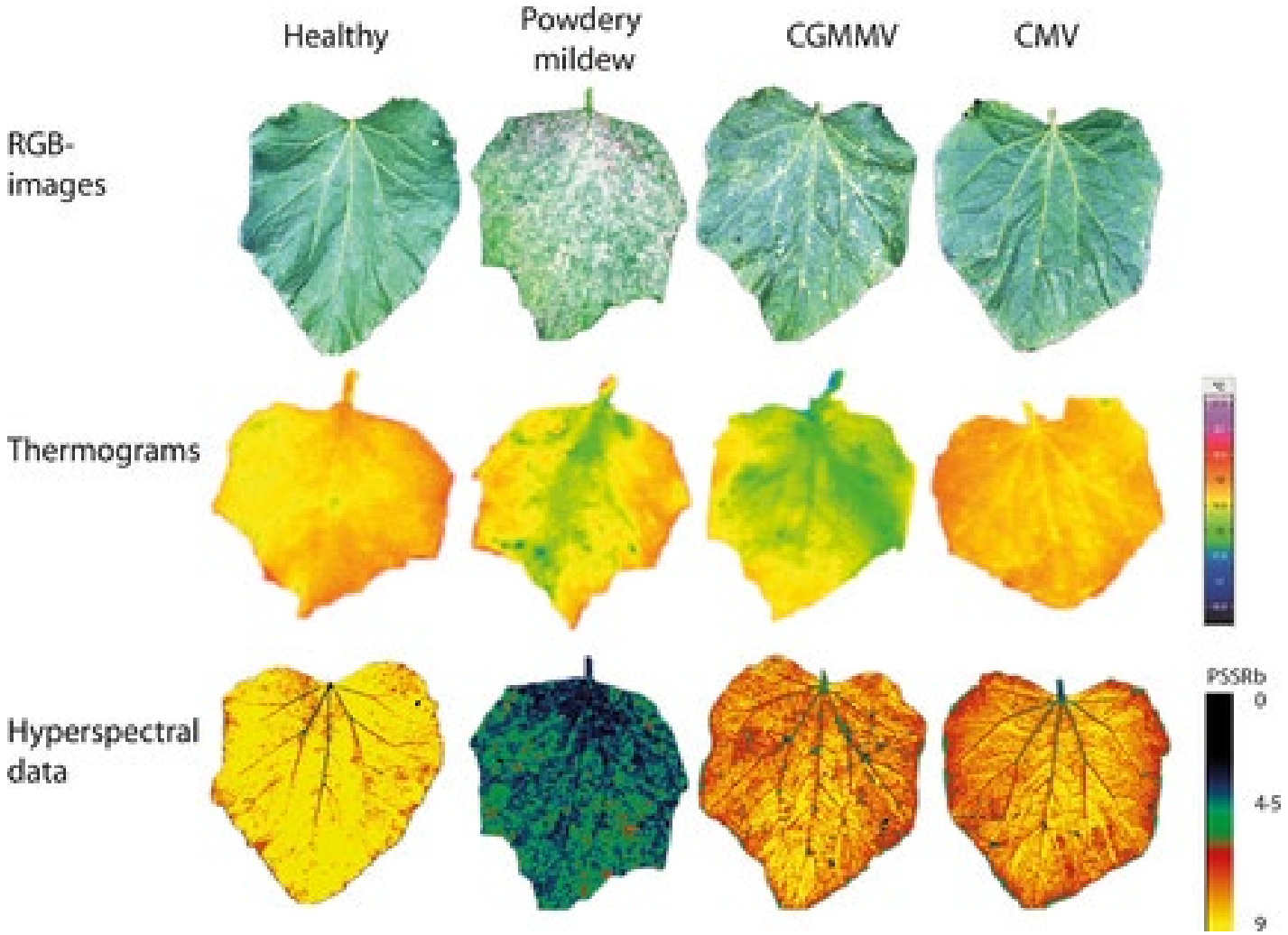
Assess quality of crop work and detect issues that affect production & labour cost.

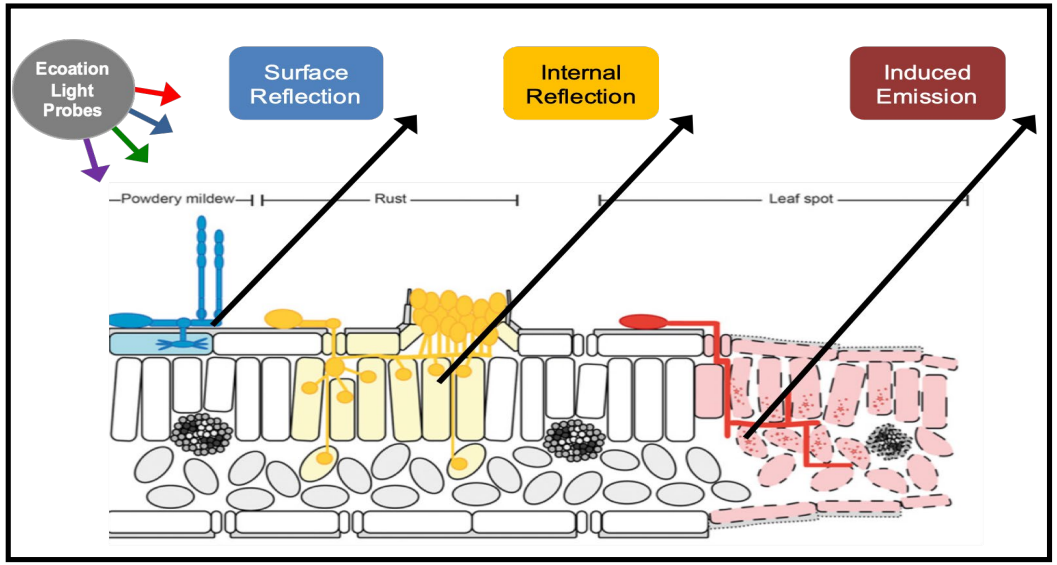
Human + Machine KNOWLEDGE PRECISION

ecoation

biobest SUSTAINABLE CROP MANAGEMENT

Beyond the visible





C. A. Berdugo, R. Zito, S. Paulus, and A.-K. Mahlein, “Fusion of sensor data for the detection and differentiation of plant diseases in cucumber,”

Plant Health Sensor

Data-driven Precision IPM
WHAT ?

1. **Data collection & recording** (identity, location, severity of pest & beneficials)
   1) Human eye (Crop Scanner, Ecoation-OKO)
   2) Sensors and Camera's (RGB, thermal, hyper-spectral)
      a) Direct observation (PATS)
      b) Indirect observation (plant stress) (Ecoation–Plant Health Sensor) → 2-step approach
      c) Traps (TrapScanner)
   3) High-resolution climate sensors (T, RH, [CO2], light intensity, …)
2. **Decision Support** (DSS)
   1) Descriptive (heatmaps, graphs)
   2) Diagnostic (root cause analysis)
   3) Predictive (models, algorithms, thresholds → risk maps)
   4) Prescriptive (based on continuous recording of actions and their effects)

ecoation

biobest SUSTAINABLE CROP MANAGEMENT

Decision Support System

a new paradigm for technical advice

Predictive
What will likely happen ?

Data

Descriptive
What happened ?
What is happening ?

Diagnostic
What caused it ?
Why does it happen ?

Prescriptive
What should/could be done about it ?

Actions

ecoation

biobest SUSTAINABLE CROP MANAGEMENT

Data-driven Precision IPM
WHAT ?

1. **Data collection & recording** (identity, location, severity of pest & beneficials)
   1) Human eye (Crop Scanner, Ecoation-OKO)
   2) Sensors and Camera's (RGB, thermal, hyper-spectral)
      a) Direct observation (PATS)
      b) Indirect observation (plant stress) (Ecoation–Plant Health Sensor) → 2-step approach
      c) Traps (TrapScanner)
2. **Decision Support** (DSS)
   1) Descriptive (heatmaps, graphs)
   2) Diagnostic (root cause analysis)
   3) Predictive (models, algorithms, thresholds → risk maps)
   4) Prescriptive (based on continuous recording of actions and their effects)
3. **Action**
   1) Bug Dispensers: (autonomous) vehicle, robot-arm (T-bot), …
   2) Spot treatments
   3) UVC robot

ecoation

biobest SUSTAINABLE CROP MANAGEMENT

Data-driven Precision IPM
WHY ?

1. Reduce production **costs** (labor cost+ availability of skilled labor)
   1) Scouting labour (2-step approach)
   2) (Precision) releasing beneficials and applying (bio)pesticides
2. Maximize **crop yield** and **quality** (Precision IPM)
   1) Even better advice with less risk (PepMV, ToBrFV, …) through remote advice
   2) Less negative impact from pests and diseases
      a) Earlier detection, allowing earlier intervention
      b) Optimal (precision) interventions (DSS) (product, rate, timing, frequency, location)
   3) Less negative impact from pesticide treatments → confidence through data !
   4) Better oversight, task management and control of work quality (large, multisite operations)
   5) Reduce/Eliminate pesticide residues (residue-free)
      a) Meet legal and extra-legal requirements ('license to supply')
      b) Ultimately provide residue-free produce

Thank you !