



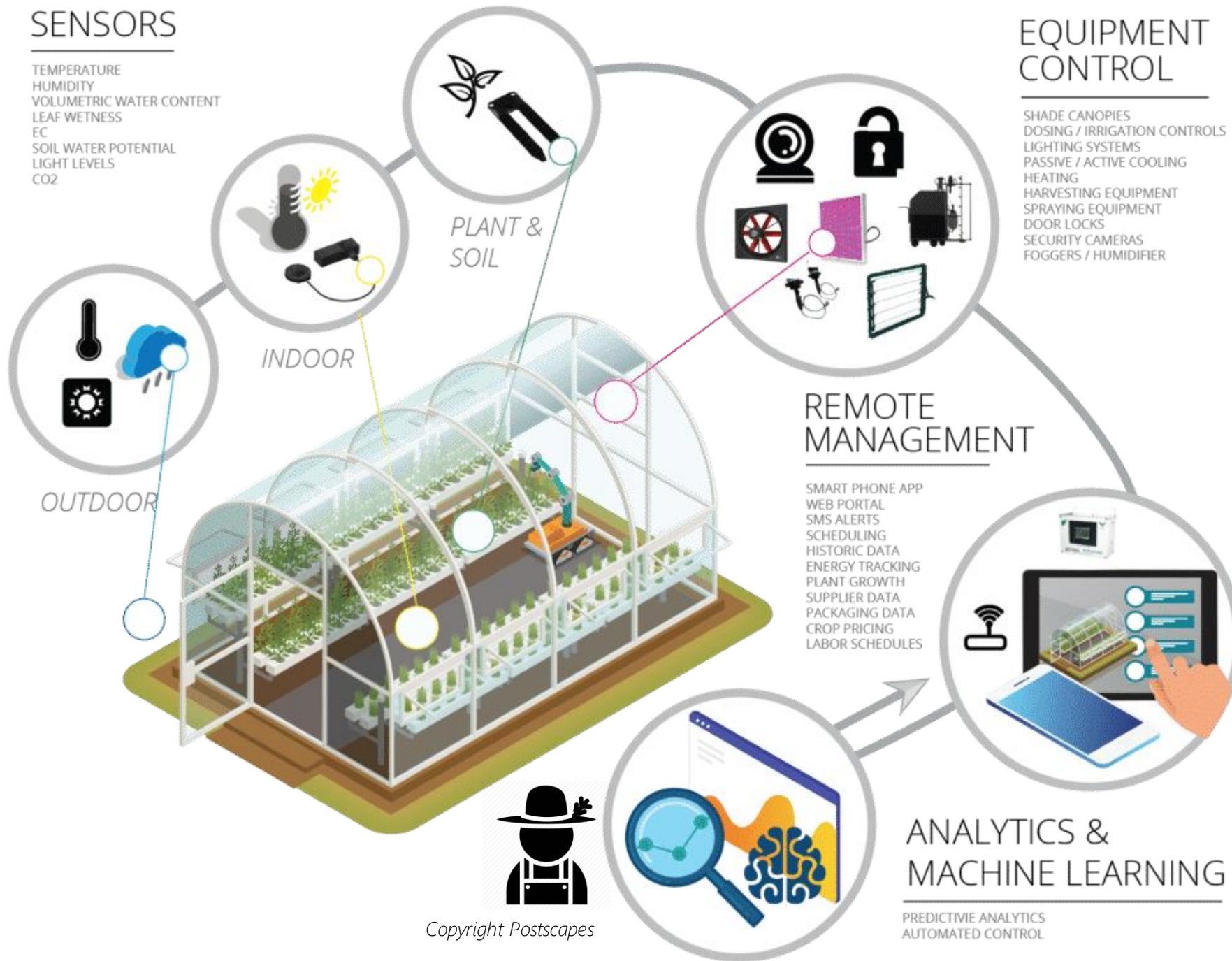
GAIA: A HYBRID-AI GREENHOUSE OPERATOR SUPPORT SYSTEM

Ellen van Bergen, Jack Verhoosel



SENSORS

- TEMPERATURE
- HUMIDITY
- VOLUMETRIC WATER CONTENT
- LEAF WETNESS
- EC
- SOIL WATER POTENTIAL
- LIGHT LEVELS
- CO2



PLANT & SOIL

- Plant leaf icon
- Soil sensor icon

INDOOR

- Hand holding a sensor icon
- Sun icon
- Light fixture icon

OUTDOOR

- Thermometer icon
- Cloud with rain icon
- Sun icon

EQUIPMENT CONTROL

- Security camera icon
- Padlock icon
- Tractor icon
- Light fixture icon
- Control panel icon
- Harvesting equipment icon

EQUIPMENT CONTROL

- SHADE CANOPIES
- DOSING / IRRIGATION CONTROLS
- LIGHTING SYSTEMS
- PASSIVE / ACTIVE COOLING
- HEATING
- HARVESTING EQUIPMENT
- SPRAYING EQUIPMENT
- DOOR LOCKS
- SECURITY CAMERAS
- FOGGERS / HUMIDIFIER

REMOTE MANAGEMENT

- SMART PHONE APP
- WEB PORTAL
- SMS ALERTS
- SCHEDULING
- HISTORIC DATA
- ENERGY TRACKING
- PLANT GROWTH
- SUPPLIER DATA
- PACKAGING DATA
- CROP PRICING
- LABOR SCHEDULES

REMOTE MANAGEMENT

- Smartphone icon
- Tablet icon
- Hand interacting with tablet icon
- Wi-Fi signal icon



ANALYTICS & MACHINE LEARNING

- Brain icon
- Network graph icon
- Hand holding a magnifying glass icon

ANALYTICS & MACHINE LEARNING

- PREDICTIVE ANALYTICS
- AUTOMATED CONTROL

Copyright Postscapes



› FOCUS ON

- › AI-based techniques for *predictive control* including the *dynamics* of the climate *and* the *crop*!
- › *Explainable advice* to the grower on which control points to set
- › Capturing *feedback and knowledge* of the grower for *co-learning* and better advice in the future.



Welcome to the GAIA dashboard

- information and explanation GAIA dashboard -

INPUT 

OUTPUT 

KNOWLEDGE BASE 

Input

Objective:

SELECT OBJECTIVE

RUN GAIA



Welcome to the GAIA dashboard

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INPUT 

OUTPUT 

KNOWLEDGE BASE 

Input

Objective:

DRY MASS

FUEL USE

DRY MASS AND FUEL USE

W GAIA



Welcome to the GAIA dashboard

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INPUT 

OUTPUT 

KNOWLEDGE BASE 

Input

Objective:

DRY MASS AND FUEL USE

Profit:

Dry mass

13.33

Euro/kg

Cost:

Fuel use

0.64

Euro/kg

RUN GAIA



Welcome to the GAIA dashboard

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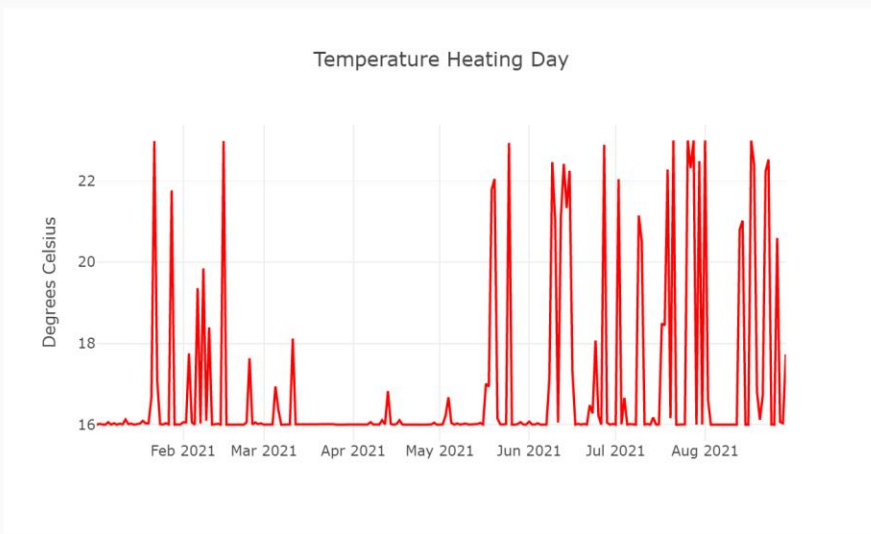
- INPUT 
- OUTPUT **
- KNOWLEDGE BASE 

Output

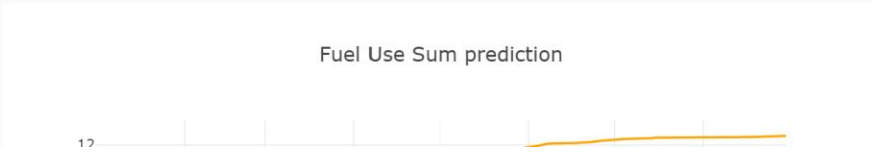
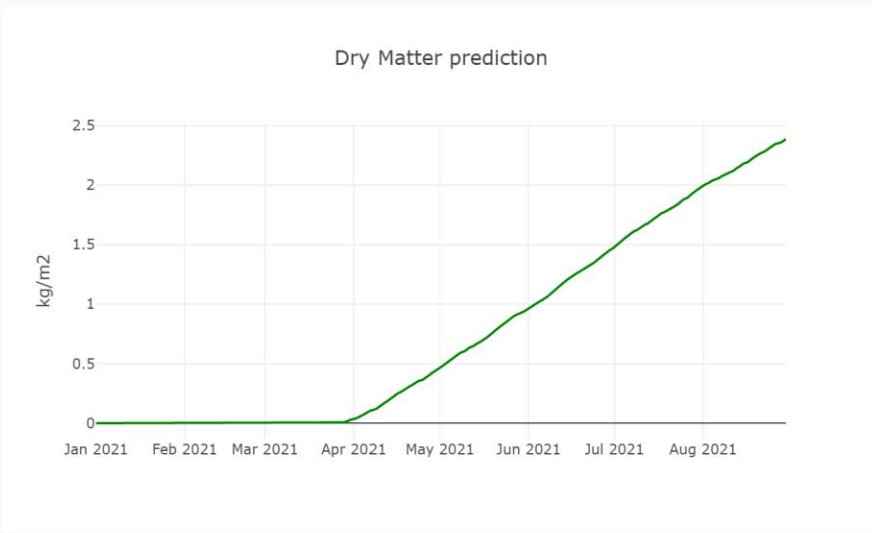
Control schedule

Time window plots:

GROWING PERIOD



Objectives



Welcome to the GAIA dashboard

- information and explanation GAIA dashboard -

INPUT 

OUTPUT 

KNOWLEDGE BASE 

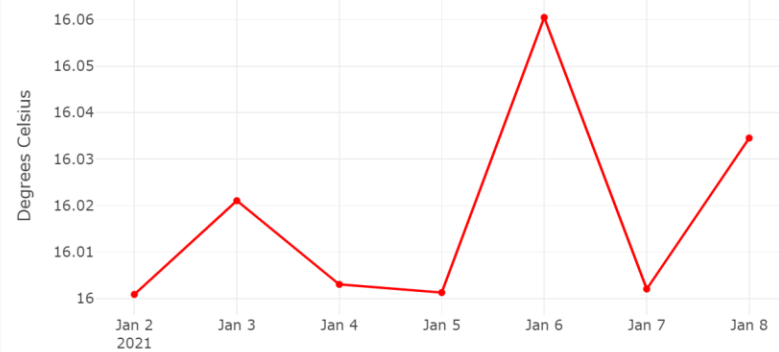
Output

Control schedule

Time window plots:

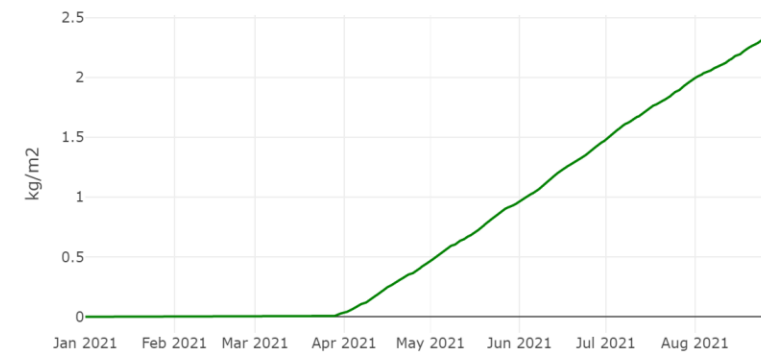
SEVEN DAYS

Temperature Heating Day



Objectives

Dry Matter prediction

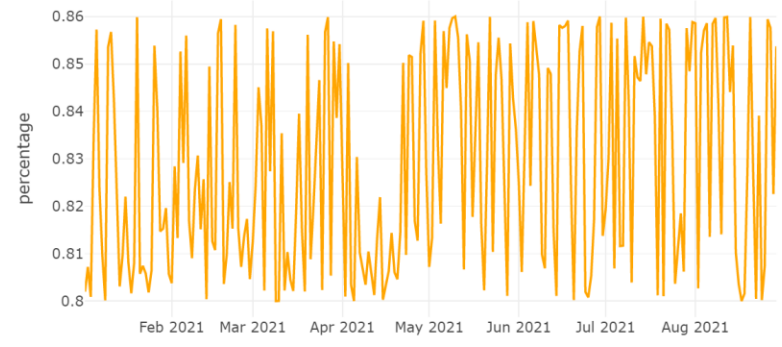


Fuel Use Sum prediction

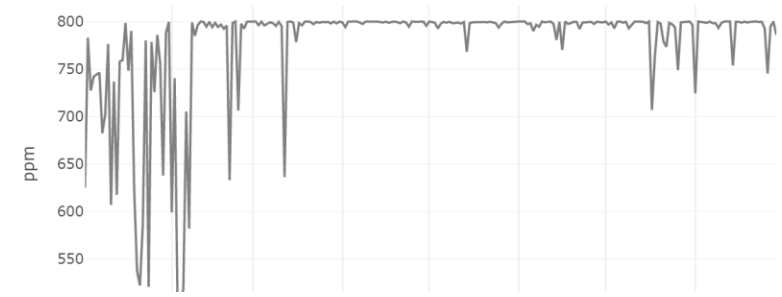




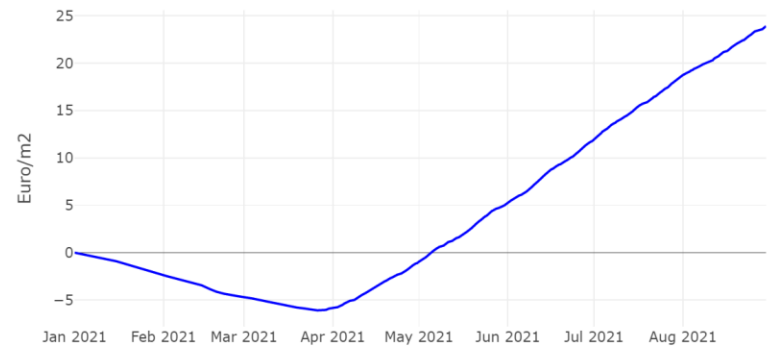
Maximum Relative Humidity



Maximum CO2



Profit prediction



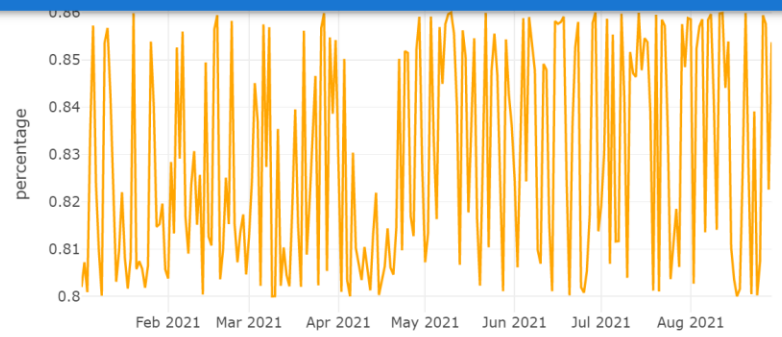
Profit prediction at the end of growing period: 23.91 Euro/m2

Feedback

The advice is in line with my way of thinking:

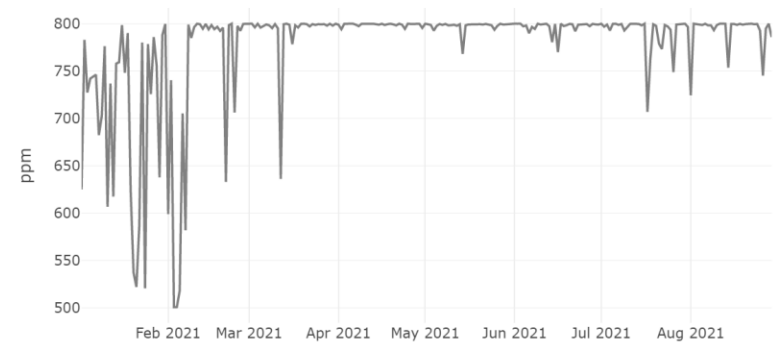
The advice is accepted:





Profit prediction at the end of growing period: 23.91 Euro/m2

Maximum CO2



Feedback

The advice is in line with my way of thinking: YES NO

The advice is accepted: YES NO


GIVE FEEDBACK

Radiation Energy Screen



Welcome to the GAIA dashboard

- information and explanation GAIA dashboard -

INPUT 

OUTPUT 

KNOWLEDGE BASE 

Knowledge Base

Current control rules:

Add control rule:

If

CO2_VPM_GREENHOUSE[PPM]

LESS THAN

1

+ AND

+ OR

then

T_SET_HEATING_DAY

GREATER THAN

20

ADD RULE

Welcome to the GAIA dashboard

- information and explanation GAIA dashboard -

INPUT 

OUTPUT 

KNOWLEDGE BASE 

Knowledge Base

Current control rules:

- If CO2_vpm_greenhouse[ppm] lessThan 1
then T_Set_Heating_Day greaterThan 20
- If RV_greenhouse[-] greaterThan 10 and wind_speed[m/s] lessThanOrEqual 0.8
then T_Set_Heating_Day greaterThan 25

Add control rule:

If

then

ADD RULE

RUN GAIA AGAIN



Welcome to the GAIA dashboard

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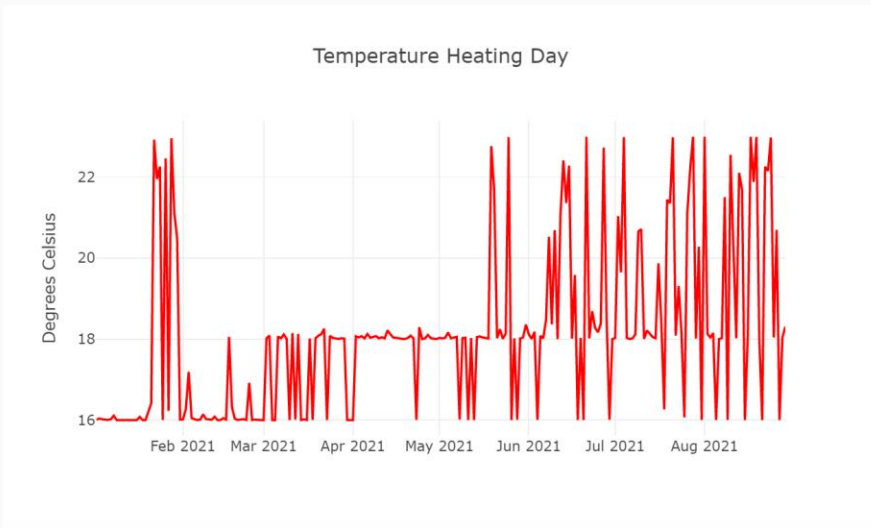
INPUT  **OUTPUT**  KNOWLEDGE BASE 

Output

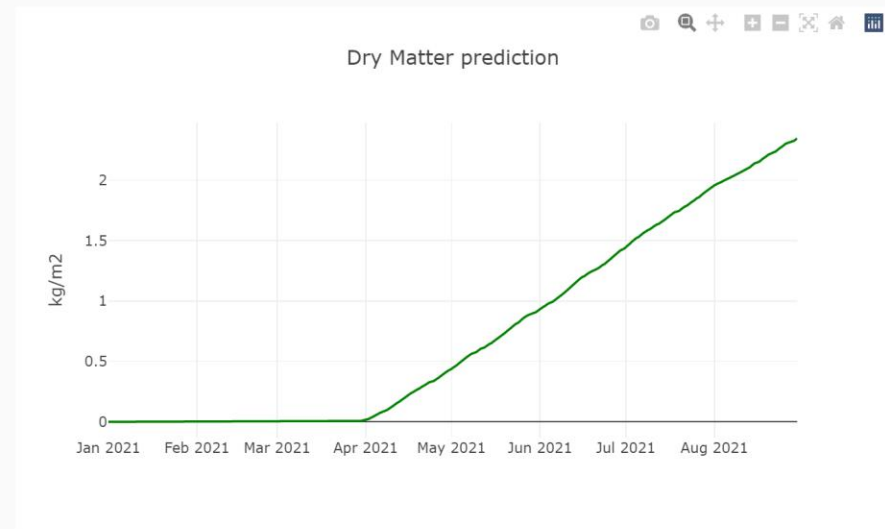
Control schedule

Time window plots:

GROWING PERIOD



Objectives



STAKEHOLDERS



65 greenhouse technology providers united in the Hortivation foundation.

Project partners:



› **MORE INFORMATION:**
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