Simulation tools for precise nutrient management of vegetable crops

EUVRIN
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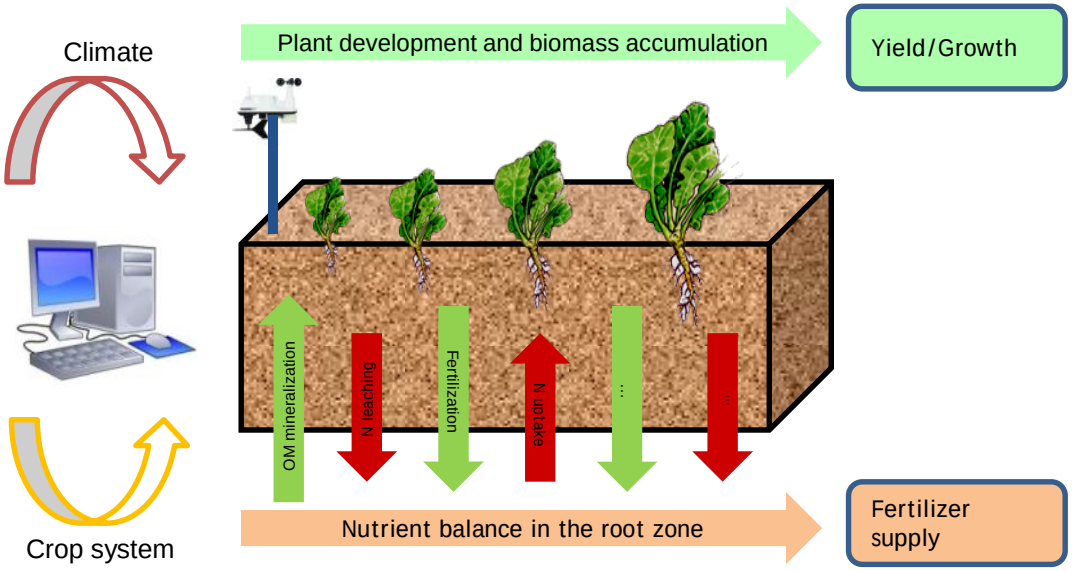
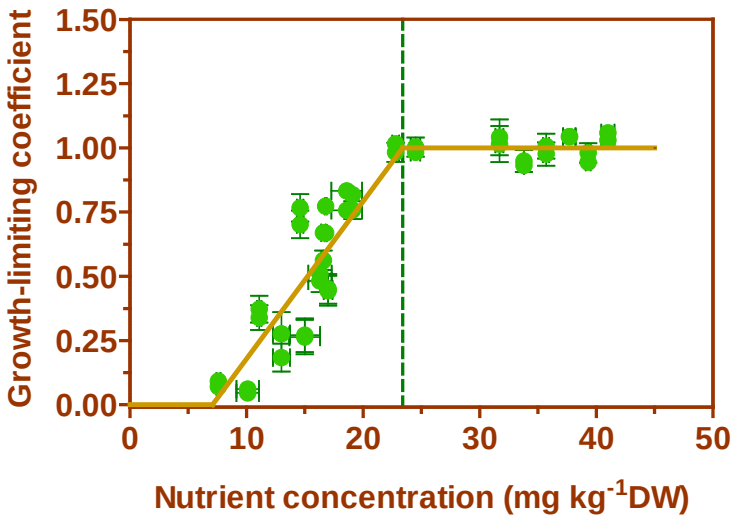
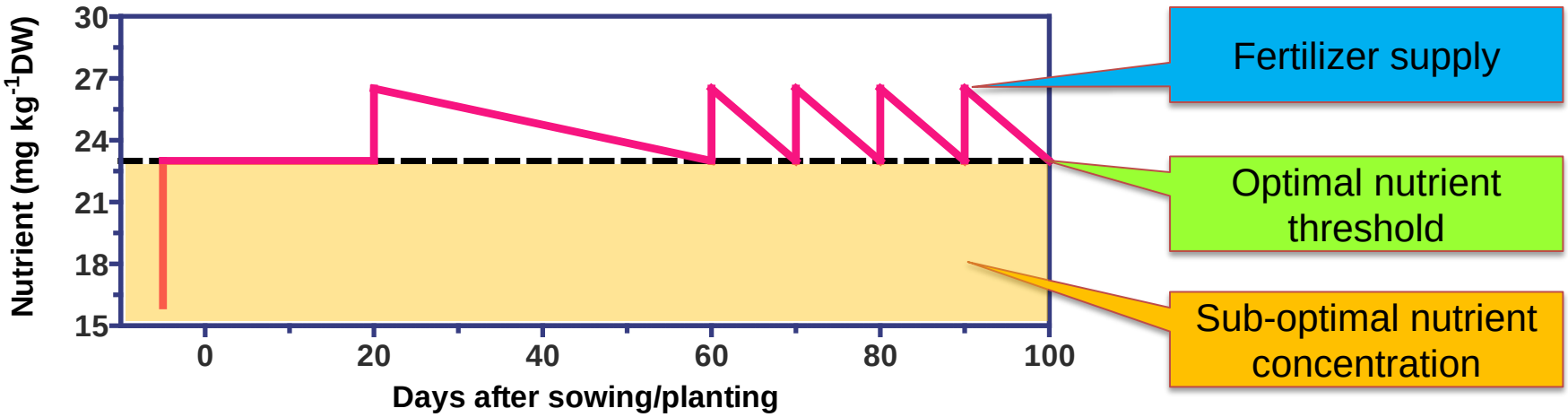
Fertilization approach adopted



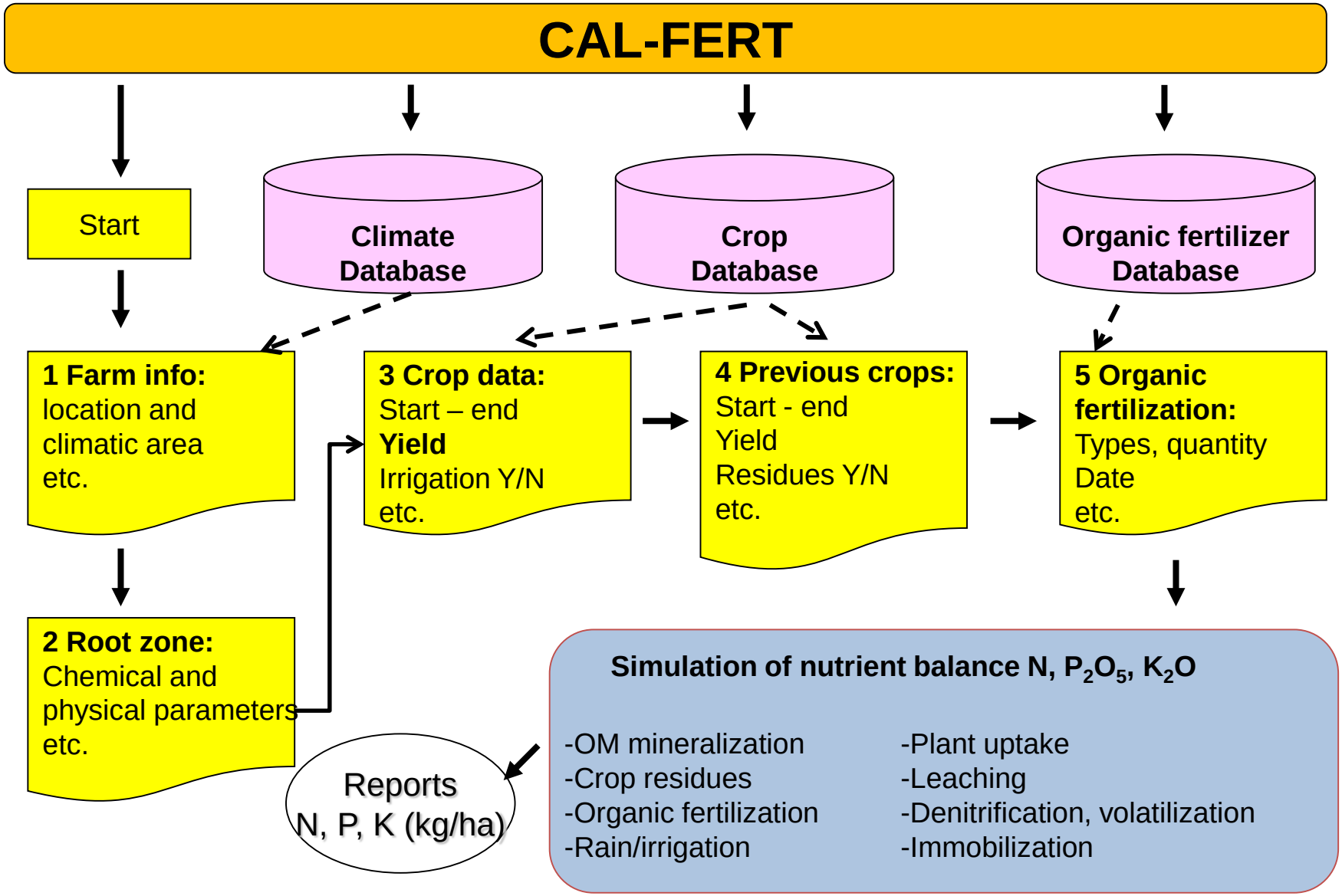




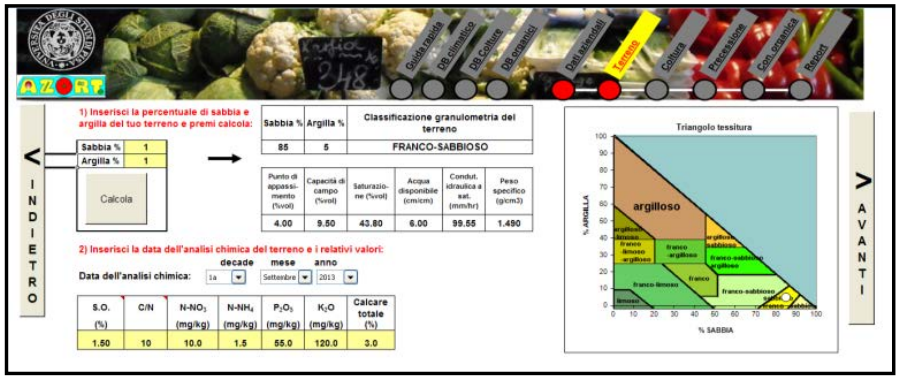
Cal-Fert and **Leafy-N** : two DSSs to support the fertilization management of vegetable crops

- Cal-Fert: static model for “prescriptive” fertilization plans before planting
  - Weekly step simulation based on historical climate data
  - Crop yield is an input (HI used for partitioning)
  - Nutrient (N P K) balance in the root zone
  - Water balance in the soil
  - Already available for users (in Italian, English version is coming soon)
  - Main outputs: advices on NPK dose for many vegetable crops (about 30)
- Leafy-N: evolution of Cal-Fert, dynamic model for on-time fertilization
  - Daily step simulation based on on-time climate data
  - Plant growth (and yield) and nutrient uptake are outputs of the model (specific partitioning coefficients for each organ)
  - Nitrogen balance in the soil
  - Water balance in the soil
  - Not yet available for users (available for research purposes)
  - Main outputs: advices on nitrogen supply (and irrigation)

Running simulations with **Cal-Fert**

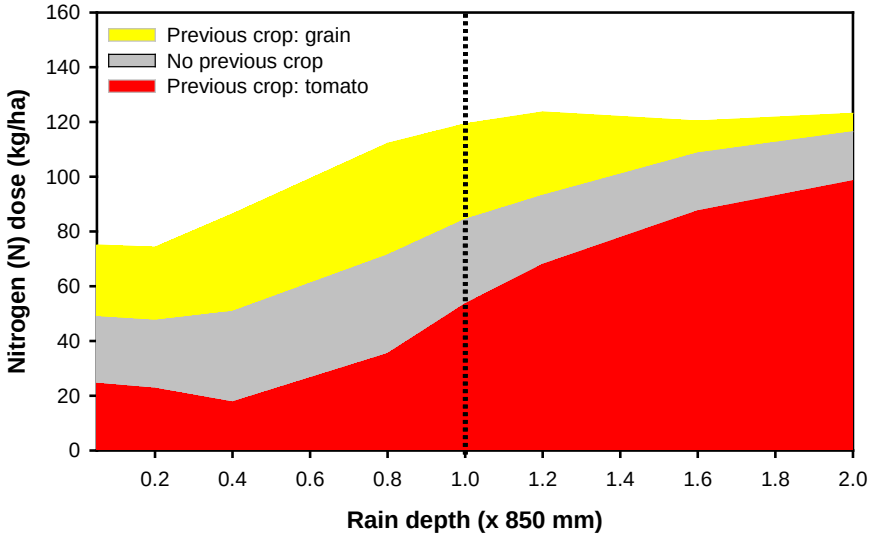


Scenario simulations with **Cal-Fert**

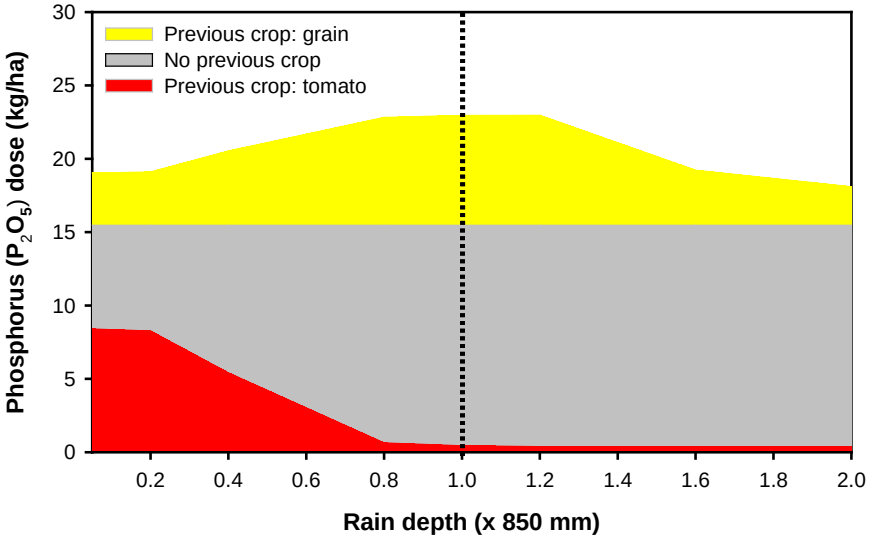


http://www.cespevi.it/softunipi/calfert.html
only in Italian for the moment

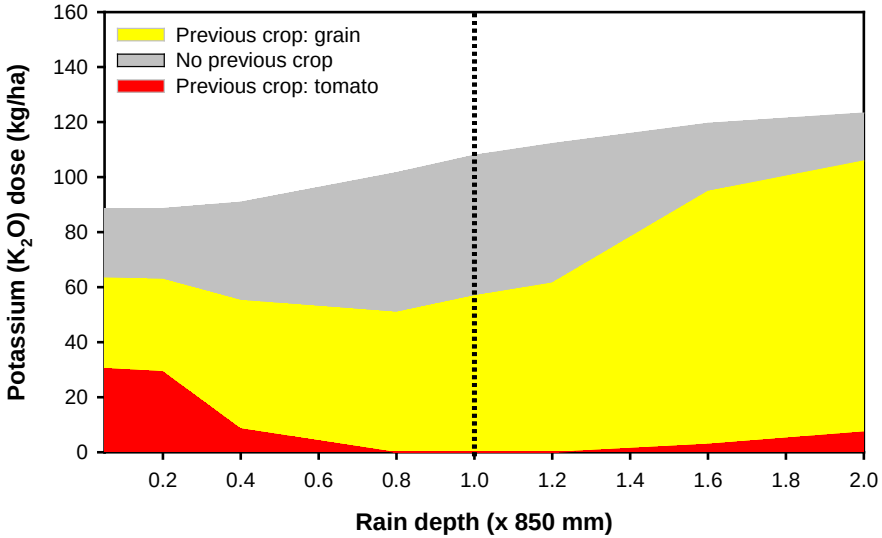
Nitrogen fertilization (for spinach)



Phosphorus fertilization (for spinach)



Potassium fertilization (for spinach)



Running simulations with **Leafy-N**

Leafy-N

Start

Crop Database

Fertilizer Database

1) Climatic variables
- Air temperature
- Global radiation
- ETP (optionally)

2) Soil characteristics
- N_{min}, limestone, C/N, soil texture, OM content, etc.

3) Cropping system
- Sowing data
- Harvest date and yield of previous crops
- Residues of previous crops

4) Organic fertilizers or manures
- Quantity
- Date
- Etc.

Simulation of N balance

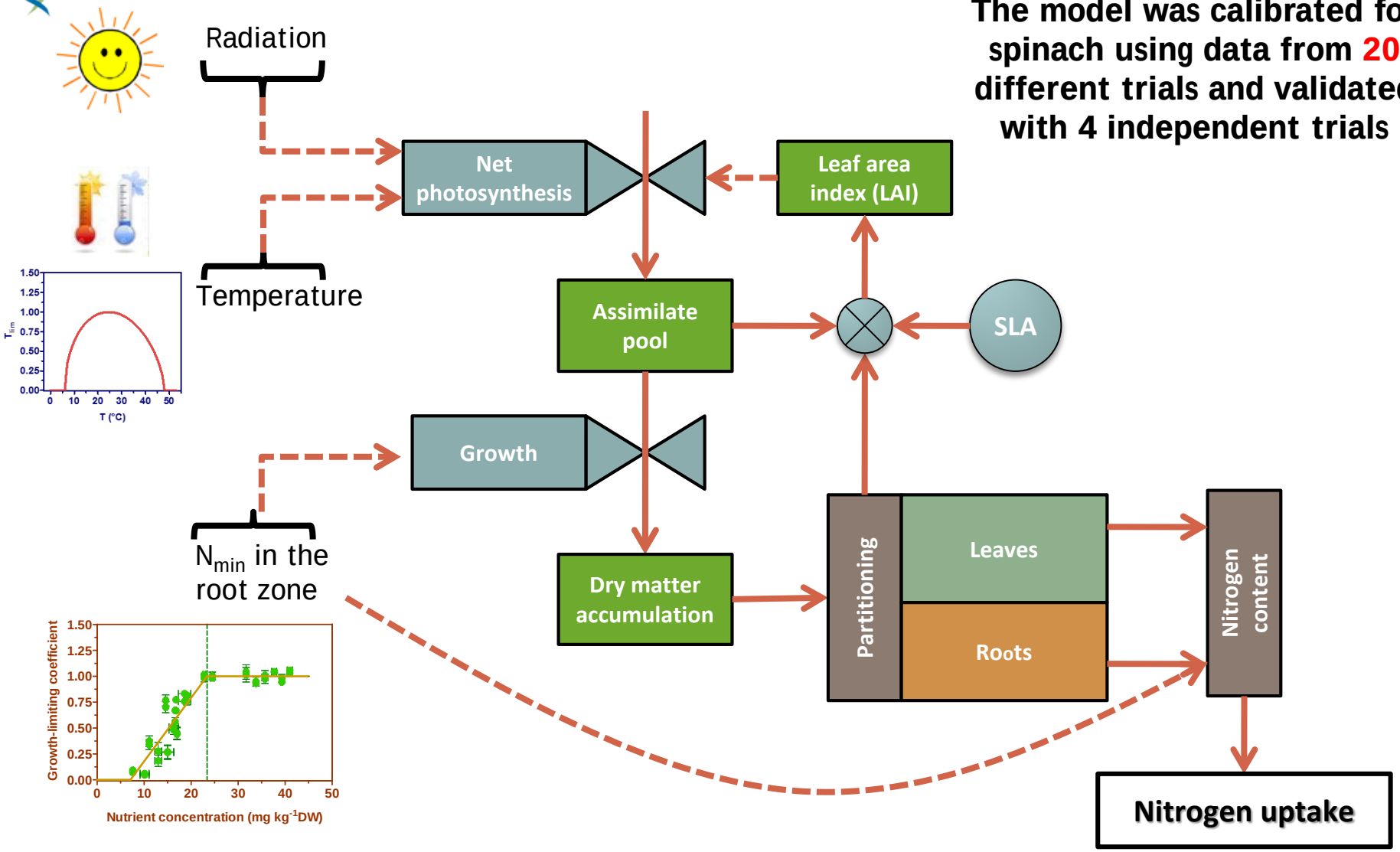
-OM mineralization
-Crop residues
-Organic fertilization
-Rain/irrigation
-Plant uptake
-Leaching
-Denitrification, volatilization
-Immobilization

5) Outputs
- N_{min} in the root zone
- Plant growth/Yield
- Water status of the root zone
- Dose of N to be supplied, if necessary

Graphs and Tabs

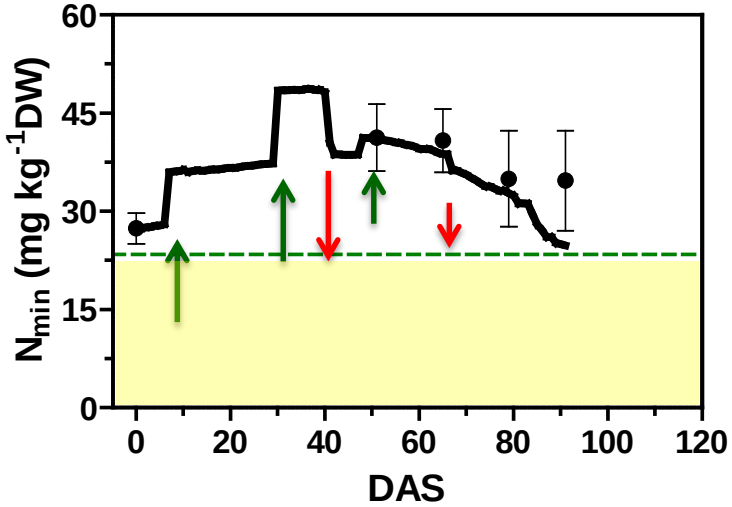
Plant growth and N uptake: model framework

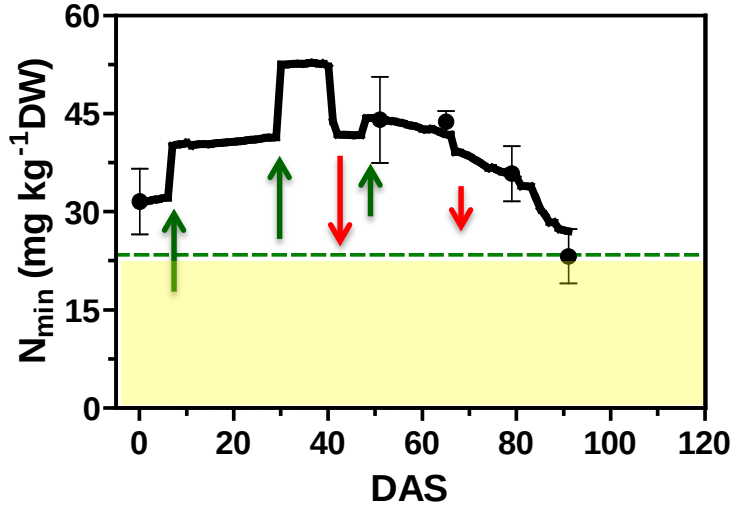
The model was calibrated for spinach using data from 20 different trials and validated with 4 independent trials



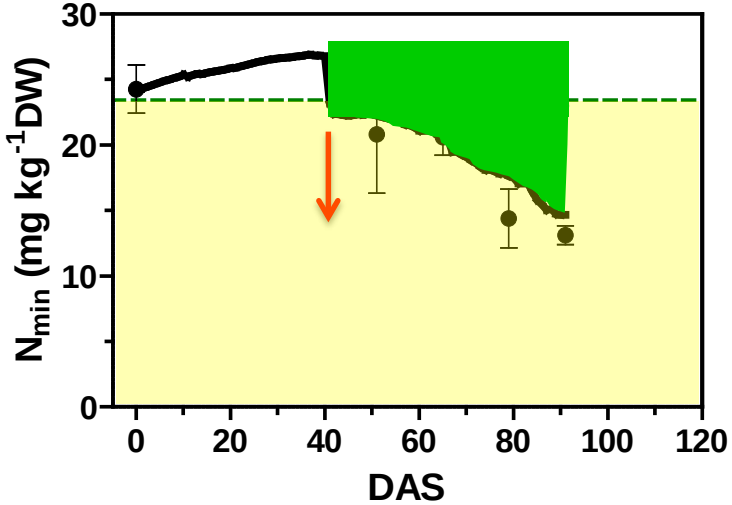
Leafy-N: model validation

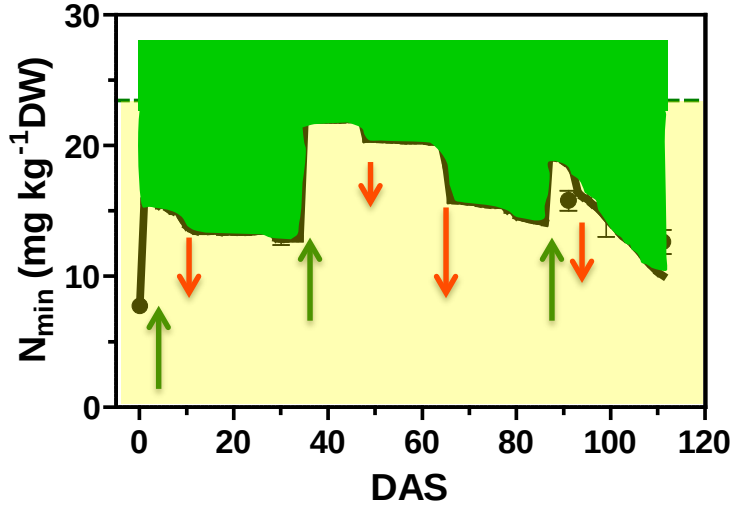
Optimal N_{min}





Sub-optimal N_{min} in the root zone





…summing up

- **Cal-Fert**: static simulator for “prescriptive” fertilization plans before planting
  - What should be done in the future
    - Wider validation under operative conditions especially under different climatic conditions
    - Translation in other languages
- **Leafy-N**: dynamic simulation for on-time fertilization plans and corrective actions
  - What should be done in the future
    - Growth models for species other than spinach
    - Wider validation under operative conditions especially under different climatic conditions
    - Available in user-friendly interface
- Not only open-field
  - **HydroTools**: designed to simulate nutrient and non-nutrient concentration in the root zone of recirculated soilless systems, and for the preparation of nutrient solutions (http://www.wur.nl/en/Research-Results/Projects-and-programmes/Euphoros-1/Calculation-tools/Hydrotools.htm)

…thank you for the attention!

…questions?

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