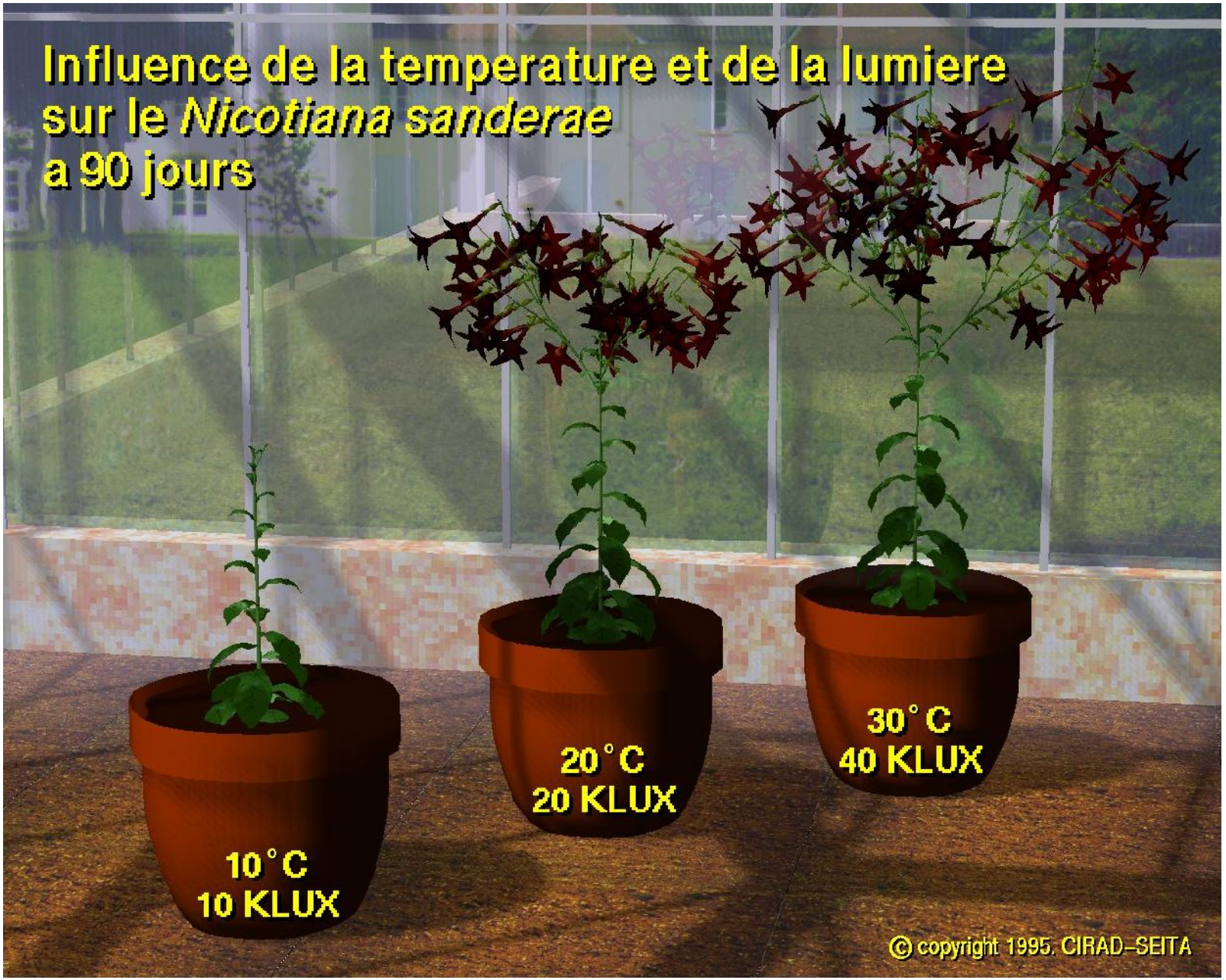
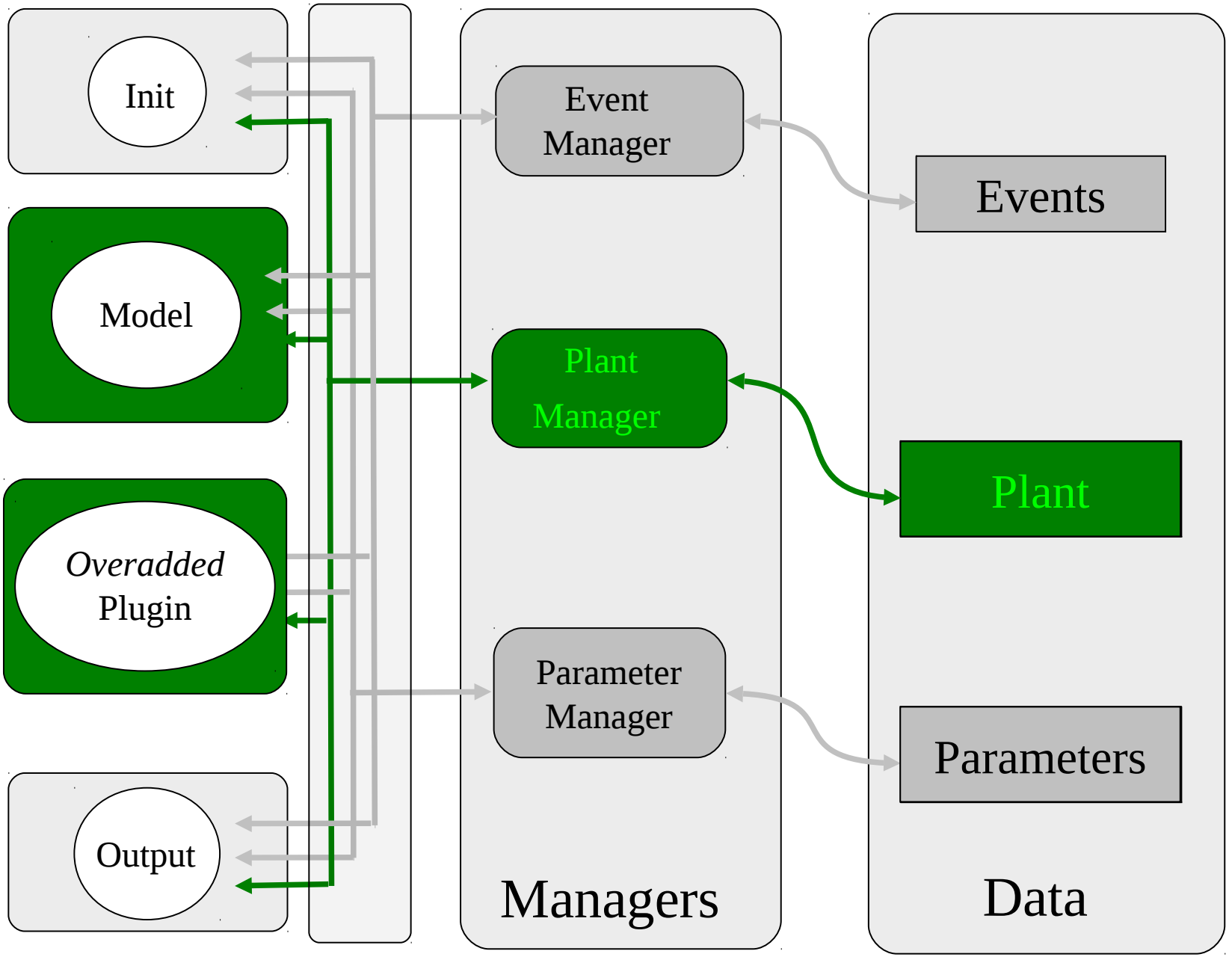
Tobaco architecture sensitive to climate



Plant description management



For instance : geometry-topology feedback, pruning

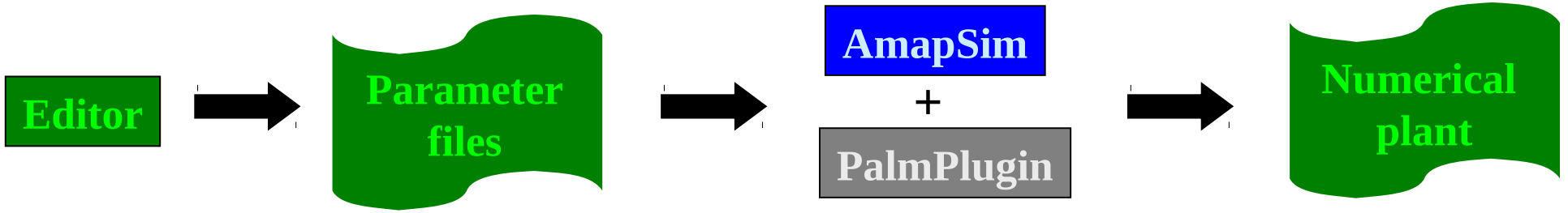
Winter rye leaves shape

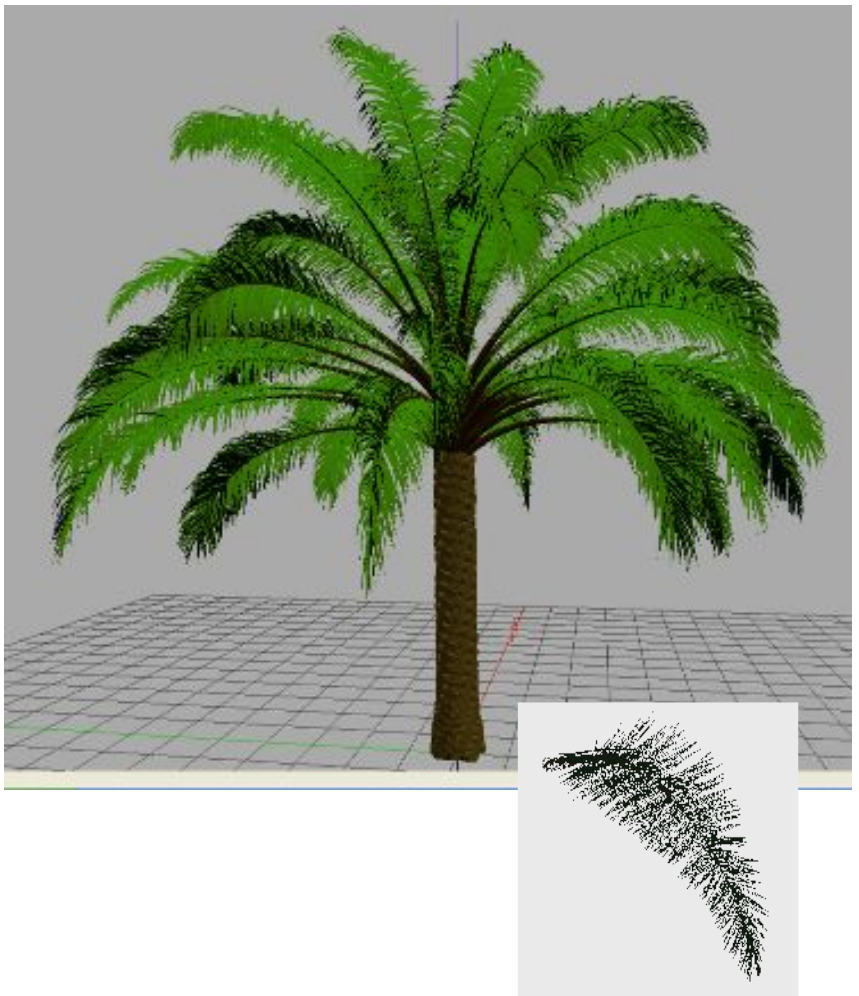
Default

Accurate

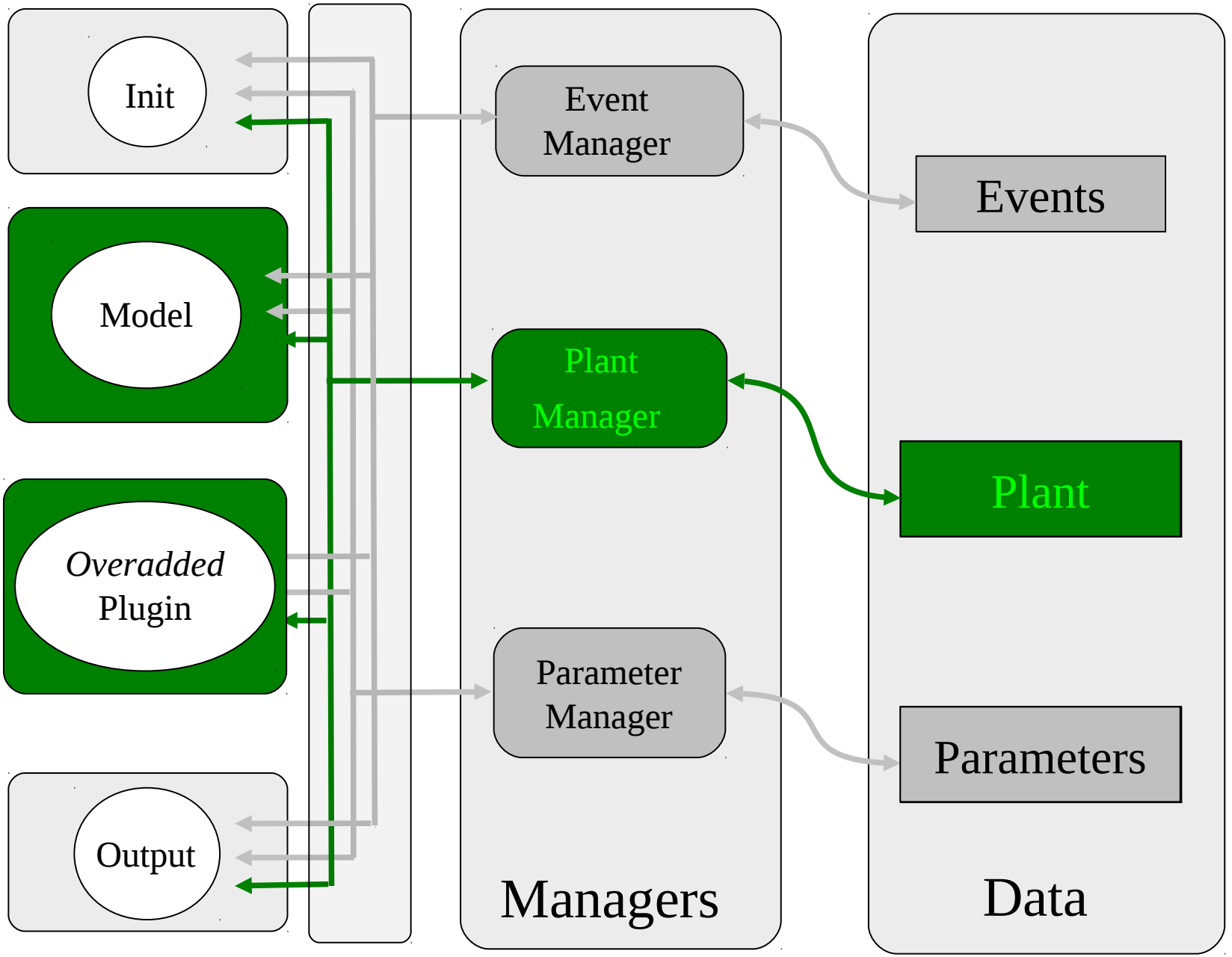
EcoPalm: Palm-oil modeling and simulation

(Julia 2007)



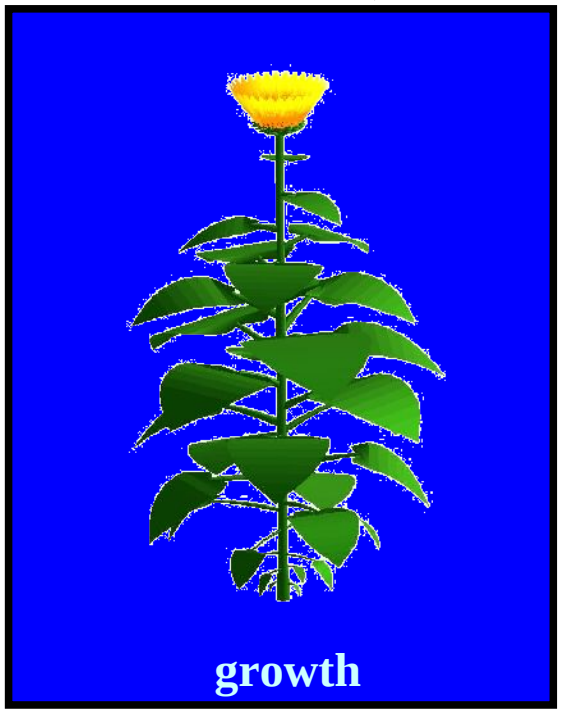


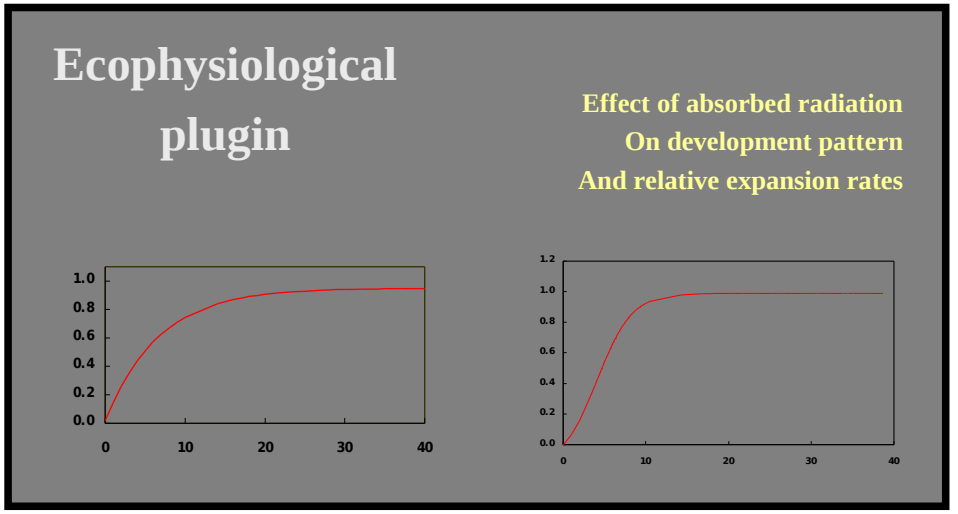
Plant description enrichment

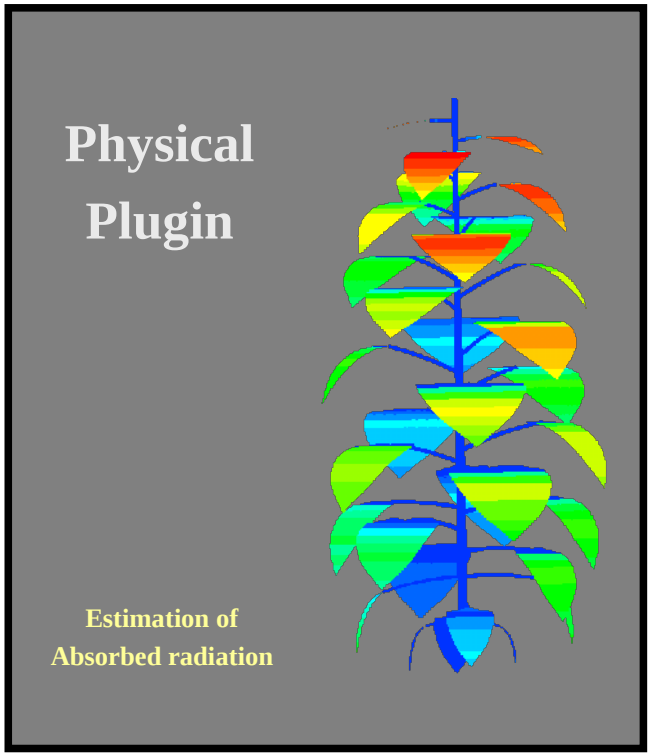


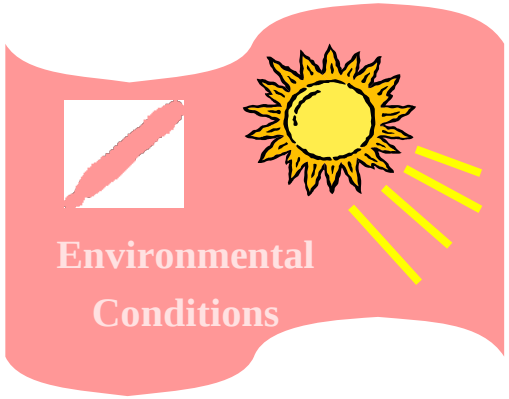
For instance : organ weight, branch boundary, plant crown volume

FSPM (Functional Structural Plant Model) approach









Leaf area simulation in thermal and radiative fluctuant conditions (Rey 2003)

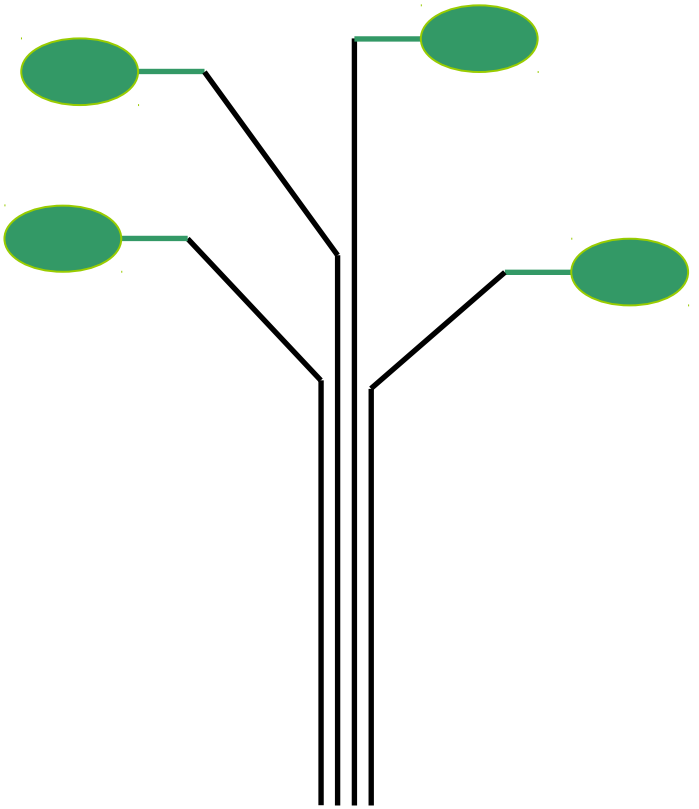
Implementation examples : 3 ways to compute organs size

- Default
- Shinozaki
  (Shinozaki et al, 1964)
- GreenLab
  (deReffye, 2001)

Shinozaki

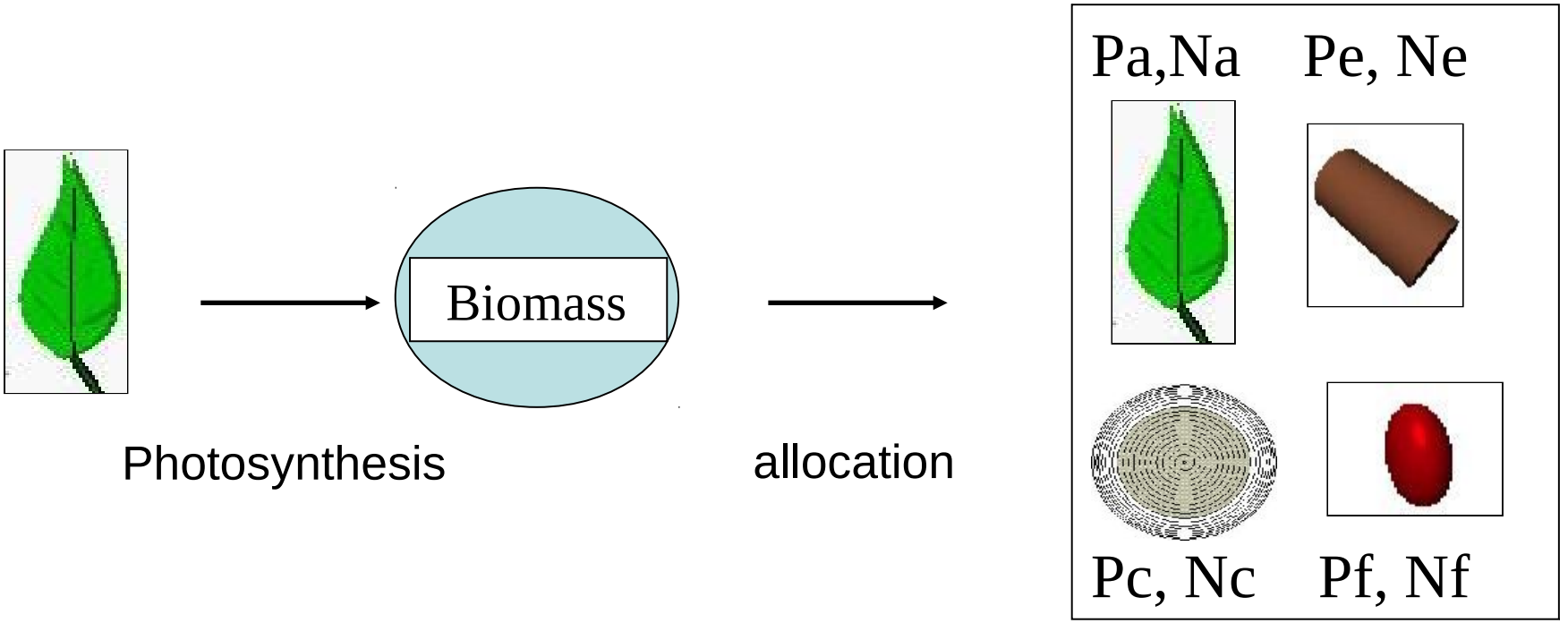
- Every leaves put their production along the way to the bole

- At each time step, the plugin computes biomass allocation and attach volume to each internode.



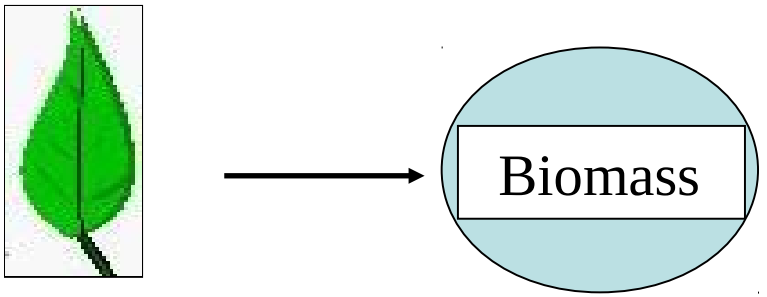
GreenLab physiology

- At each time step, according to current plant architecture, the plugin computes biomass production, allocation and attach volume to each organ.



GreenLab physiology

- Biomass is created according to light interception and efficiency of leaves



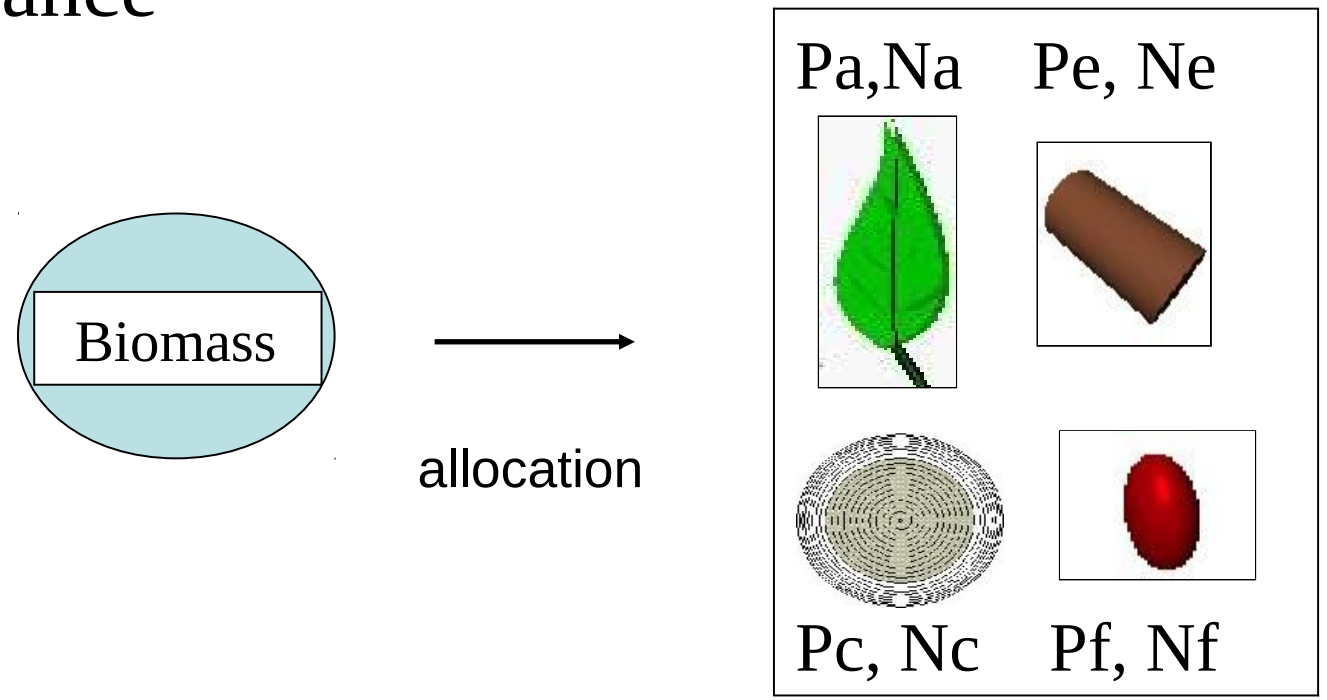
Photosynthesis

$$Q(n) = \frac{E(n)Sp}{r1 * r2} * \left(1 - \exp\left(-r2\,\frac{S(n)}{Sp}\right)\right)$$

$$E(n) = E_{max}\left(1 - e^{-kL_{mean}(n)}\right)$$

GreenLab physiology

- Global Biomass pool is shared according to sink balance



Biomass for an organ

$$qa = Q * \frac{Pa}{NaPa + NePe + NcPc + NfPf}$$

Comparison

Default

Shinozaki

GreenLab

Effect of density on tomato (Dong QiaoXue, 2006)

- GreenLab (deReffye, 2001)
- Radiosity (Soler, 2003)

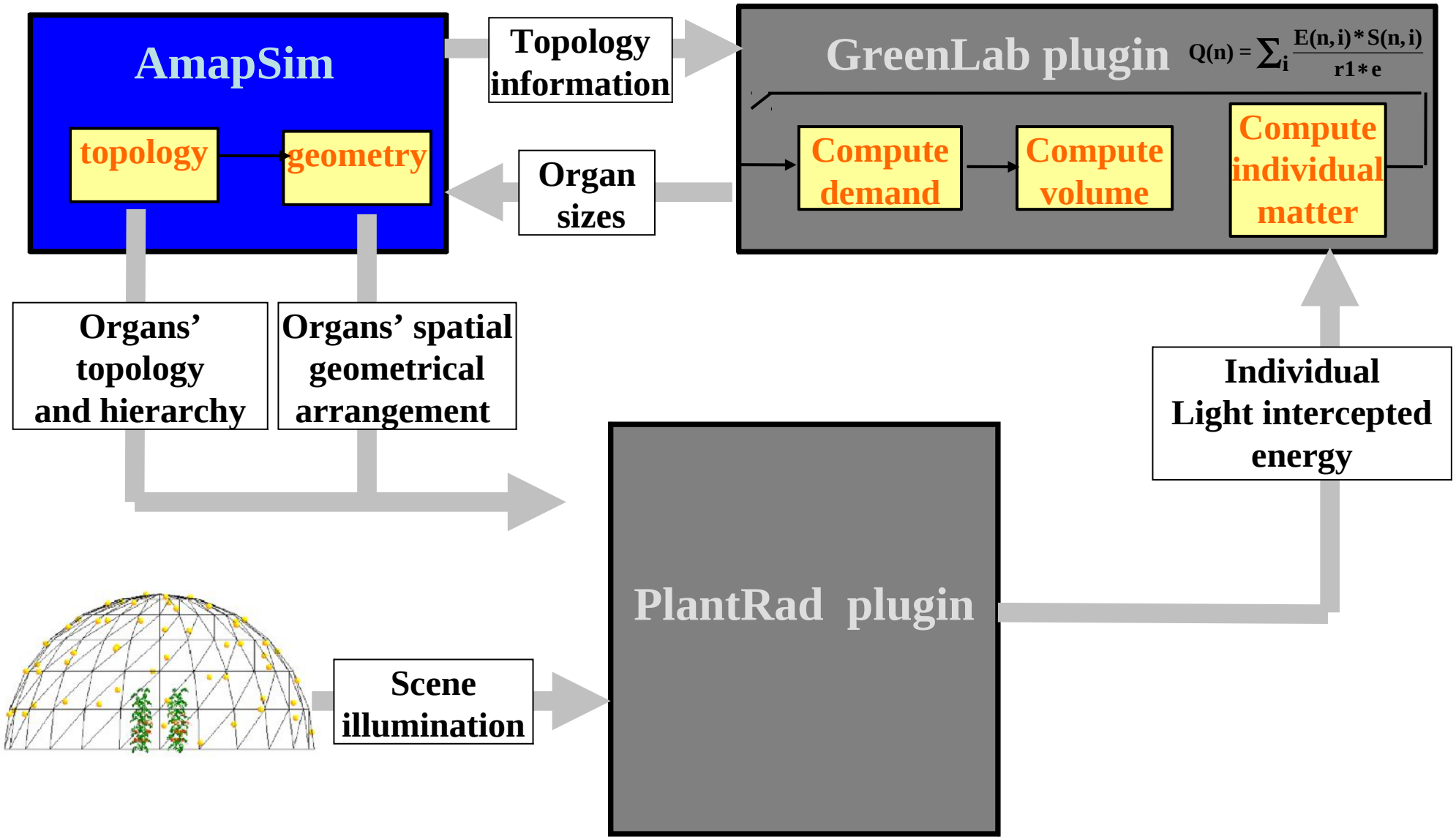
} greenhouse tomato growth (Dong QiaoXue, 2006)

Effect of density on tomato

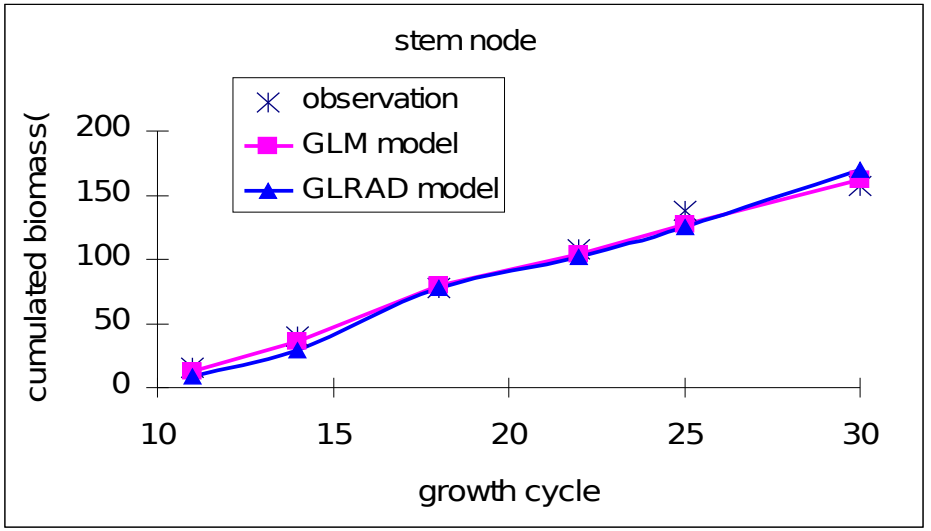
Lay out
Each plant has a 30x30cm space to occupy

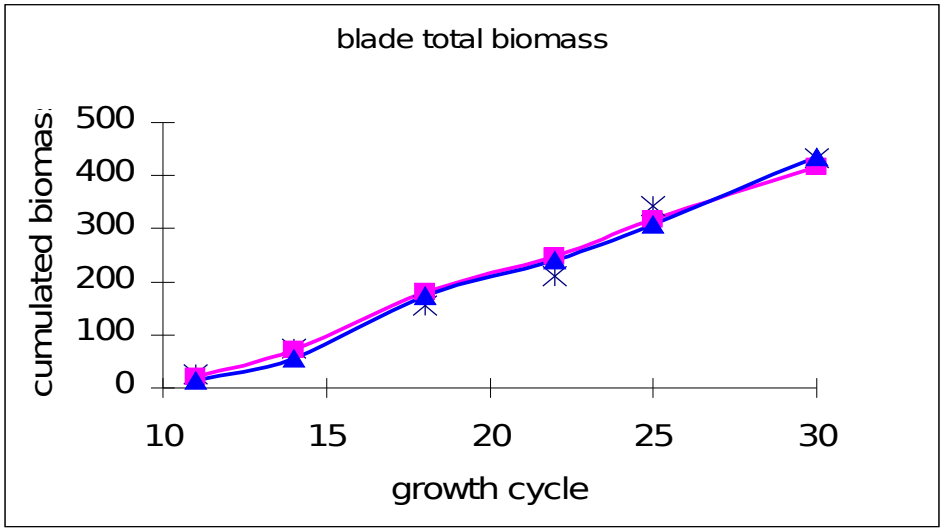
Isolated
A plant is considered isolated if there is no shading due to other plants

Effect of density on tomato
AmapSim + Greenlab + PlantRad

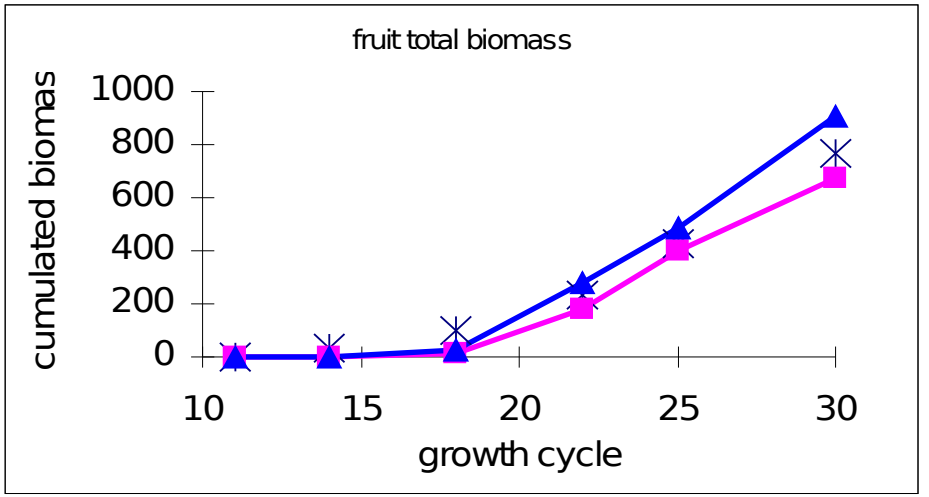


After calibration, Comparison of Beer & Rad models in Tomato growth prediction





Both Models give similar results.



I. Introduction

II. Plant model

III. Software architecture

IV. Interactive software interface

V. Conclusion and future works

Results

- A generic model for plant architecture
- Faithfull to botany
- A plant simulation framework
- Homogeneous growth simulation
- Open to external interaction

But

- Only one model provided
- Low level of model functional change facilities

Future work

- Need for more genericity on tools
  - In plant description
  - For comunication means
  - For output
- Simulation model needs to be more modular
- Constructed thanks to assembly of meta modeling blocks
- Other models to host (GL, Ecomeristem, DigR)