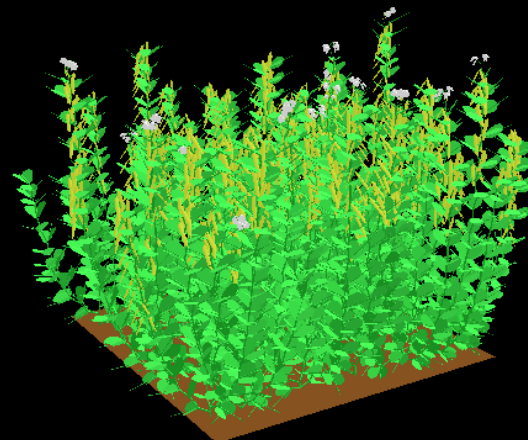


IDEOTYPE CONSTRUCTION USING AN ARCHITECTURAL MODEL OF PEA

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Végétale et
Agroécologie



- Need for growing legume species in Europe (vegetable proteins, sustainable agrosystems)
- Pea (*Pisum sativum*) : a main crop legume (3 millions tons in Europe; Duc, 2010)
- Limited productivity due to fungal foliar diseases:
Ascochyta Blight (*Mycosphaerella pinodes*), stem and pod rot (*Sclerotinia sclerotiorum*), powdery mildew (*Erysiphe pisi*)...
- Reduction of leaf area that affects light interception and biomass accumulation



Ascochyta Blight
(*Mycosphaerella pinodes*)



Stem rot
(*Sclerotinia sclerotiorum*)



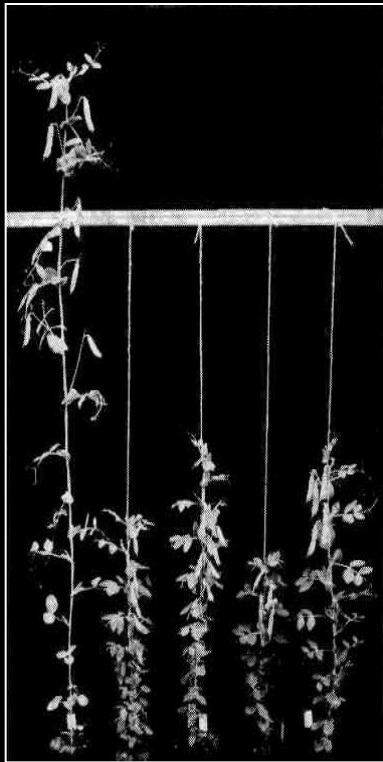
Powdery mildew
(*Erysiphe pisi*)



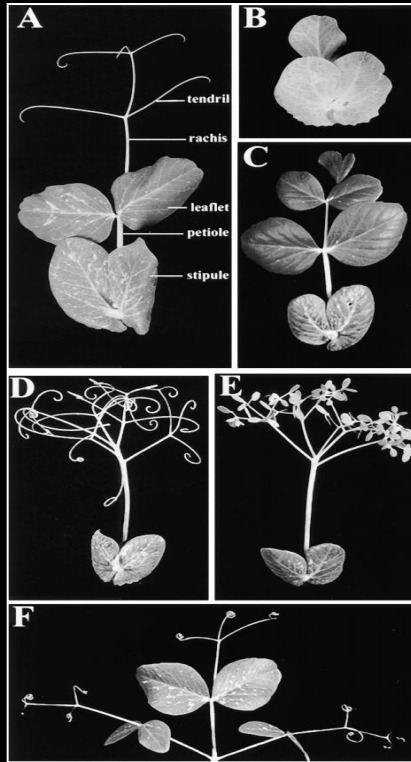
Disease development is strongly affected by plant architecture

- Plant architecture determines:
 - Phylloclimate (light, temperature, humidity...) (Chelle, 2005)
 - Plant functioning (photosynthesis, water status...)

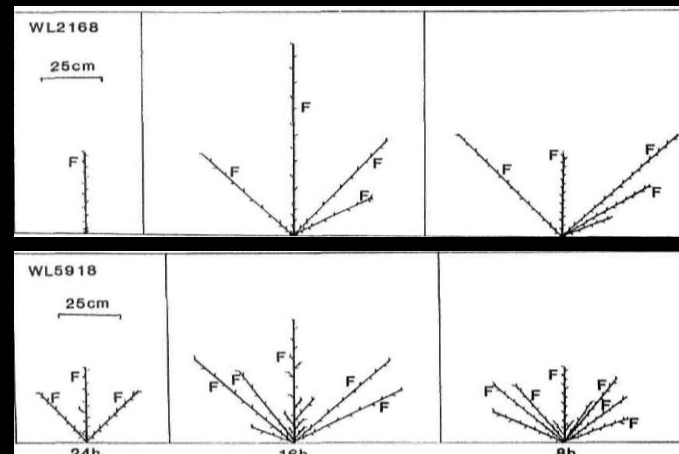
- Variability of architectural parameters of pea: plant height, spatial distribution of leaf area, lateral branching... (Béasse *et al.*, 2000; Le May *et al.*, 2009)
- Virtual plant models: suitable tools for studying plant–pathogen interactions and diseases dispersal (Robert *et al.*, 2008)



Kusnadi *et al.* (1992)



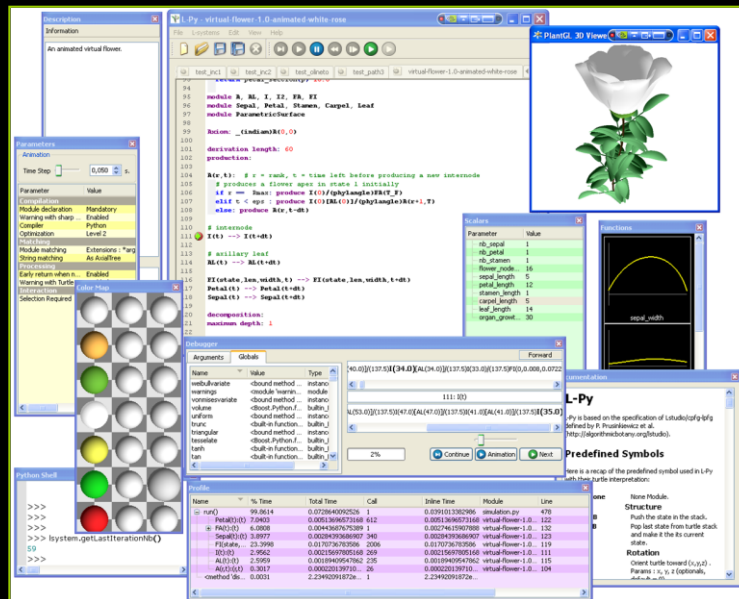
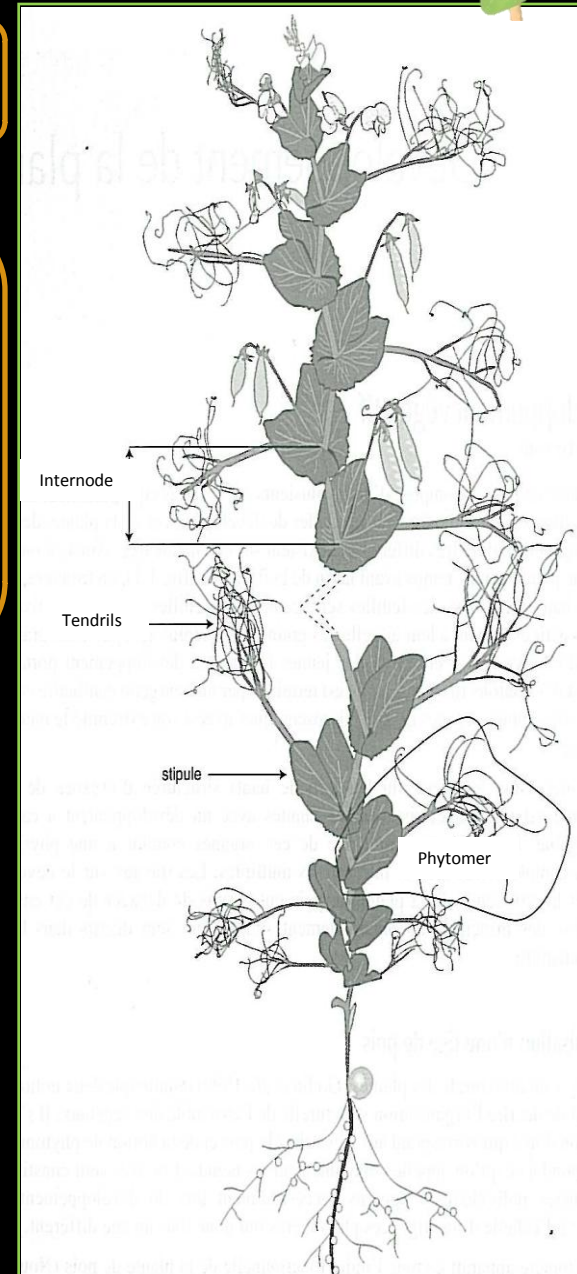
Gourlay *et al.* (2000)

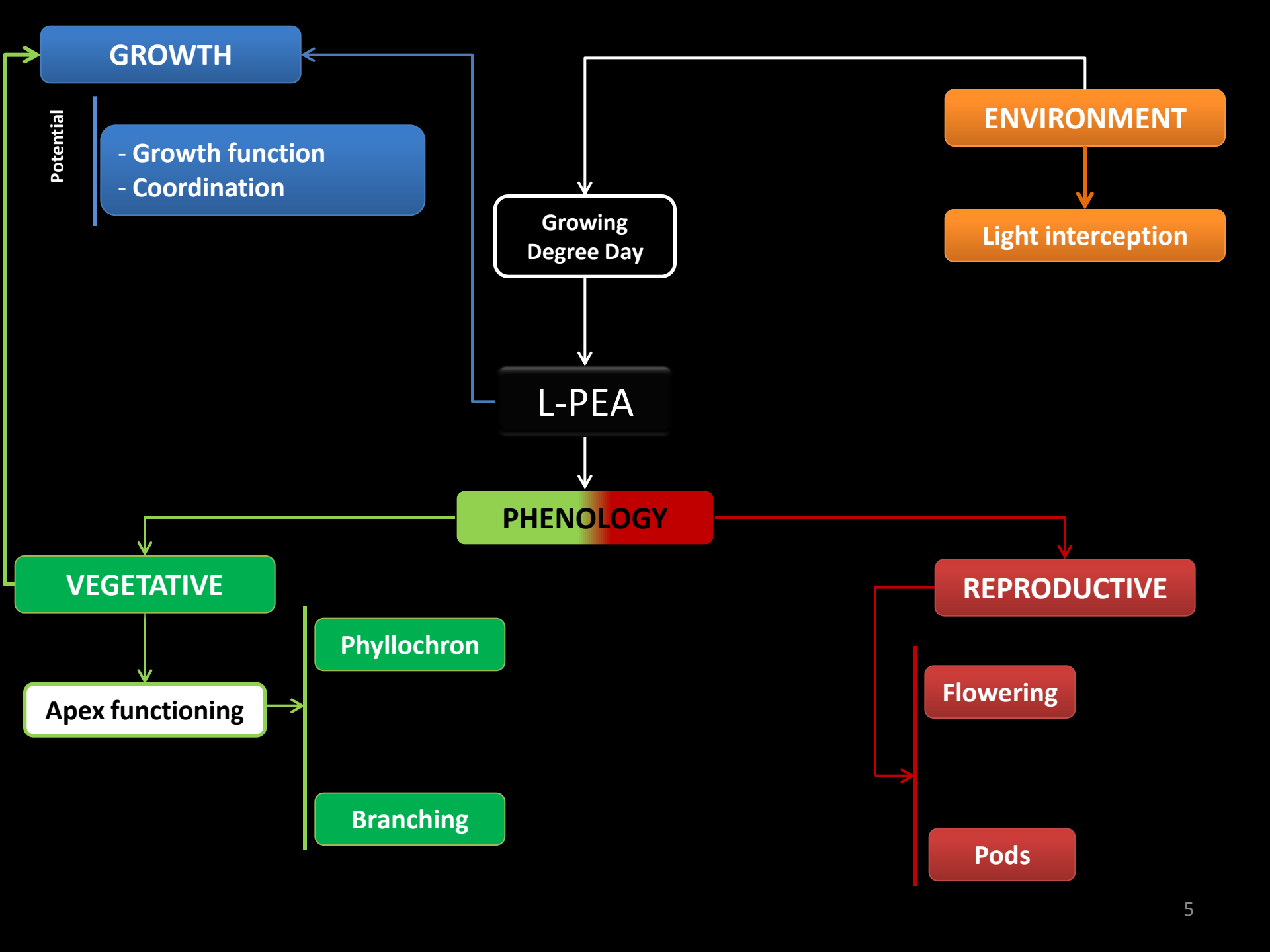




Aim: Development of a deterministic architectural model of pea

- **Formalism: based on L-System** (Prunskiewicz and Lindenmayer, 1990) : fundamental grammar describing plant architecture as a collection of modules (phytomers)
- **Model developed on the platform L-Py: L-System coupled to a dynamic language Python** (Boudon *et al.*, 2012)







VEGETATIVE

Apex functioning

- Internodes
- Stipules
- (Leaflets)
- Axillary bud

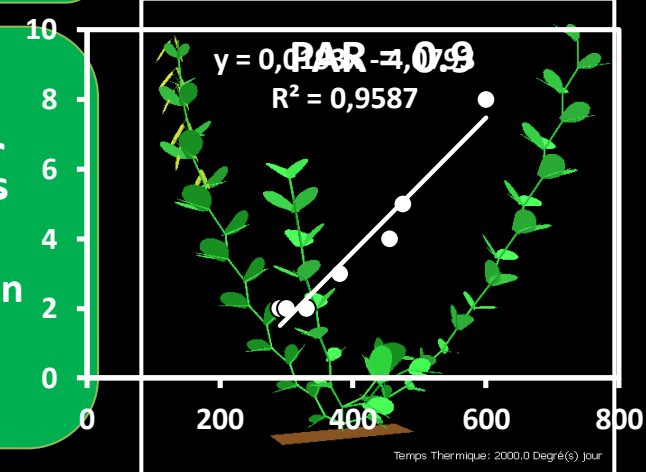
Phyllochron

- Phyllochron
- Maximum number of phytomer per axis

Branching

- Time of branching
- Nodal position
- Number of branches
- Independent phenology than main stem
- Tropism

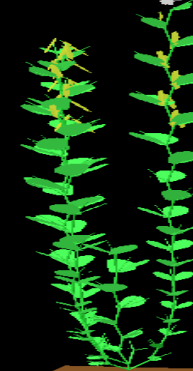
Number of phytomers



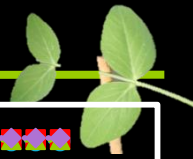
- PAR intercepted by apex used to estimate the R/FR ratio (Escobar-Gutiérrez *et al.*, 2009)
- Tropism of stems depending on PAR and R/FR ratio (Gautier *et al.*, 2000)

- Parameters: random selection on data (mean, SD)
- Take into account the variability of the population

Thermal Time (DD)
PAR = 0.1



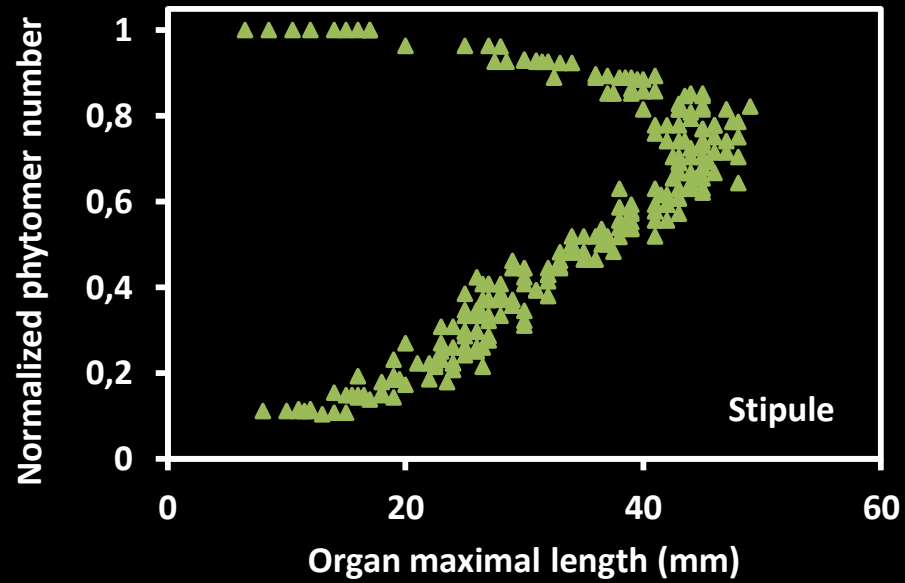
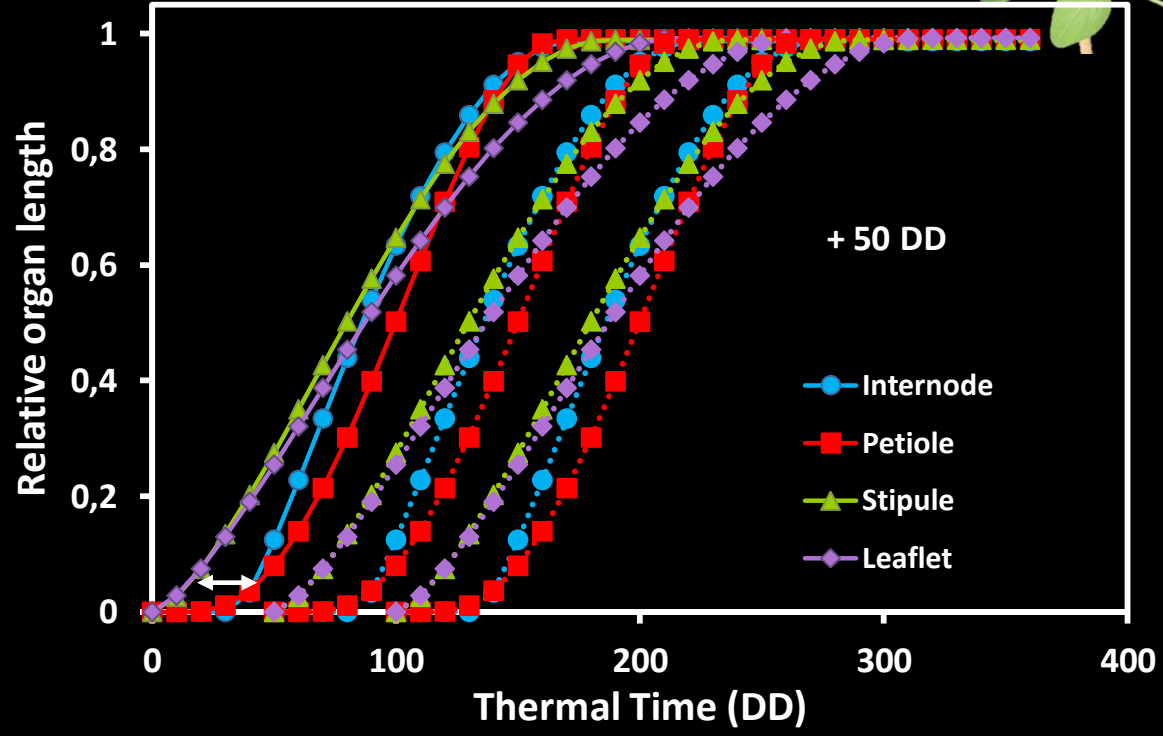
L-Pea – Growth module

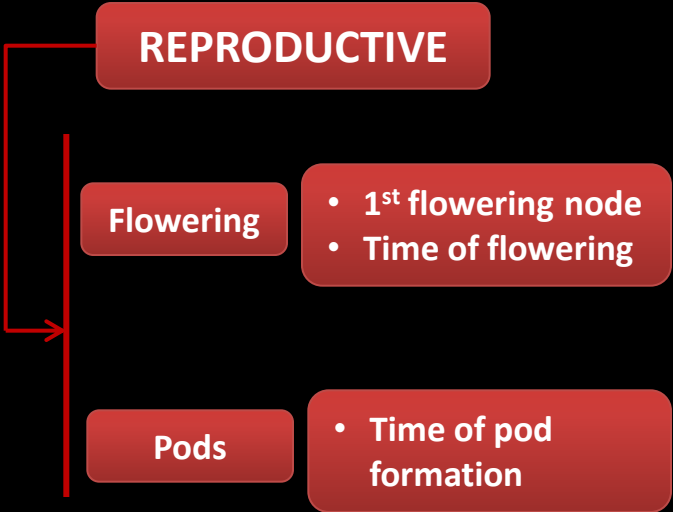


GROWTH

Potential

- Beta growth function for each organ
- Coordination
- Vertical profile of maximum length



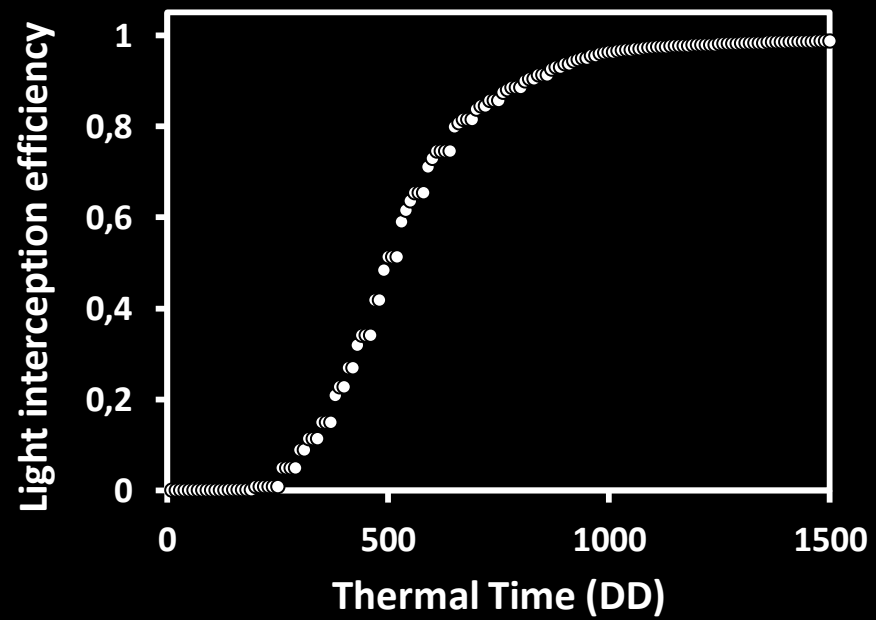
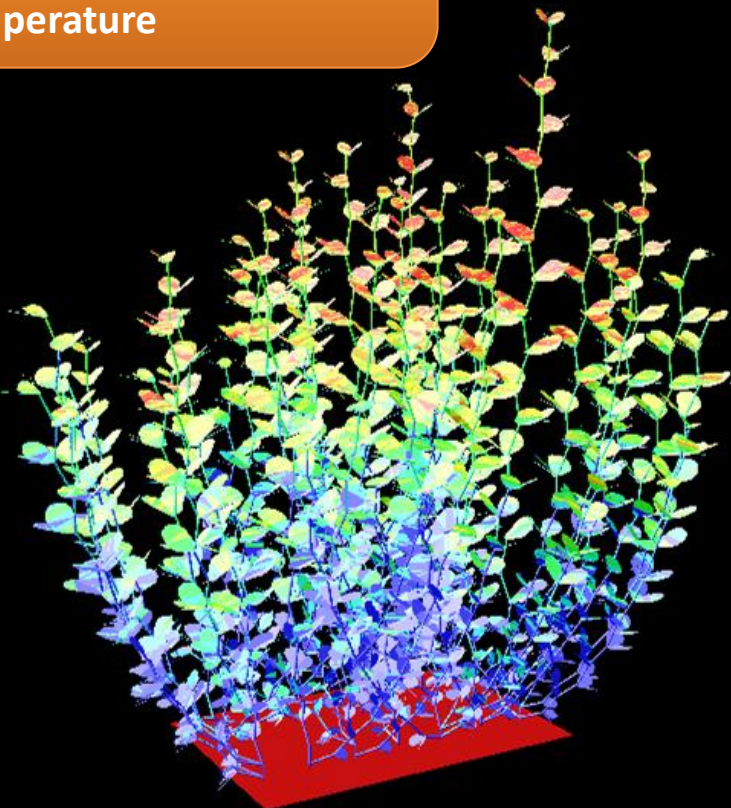




ENVIRONMENT

- Abiotic :
 - Light
 - Water
 - Temperature
- Biotic :
 - Diseases
 - Weeds

• L-Pea coupled to a radiative model (Chelle and Andrieu, 1998) in Openalea platform (Pradal *et al.*, 2008)

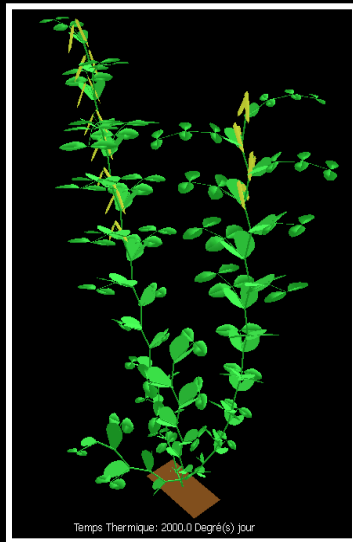




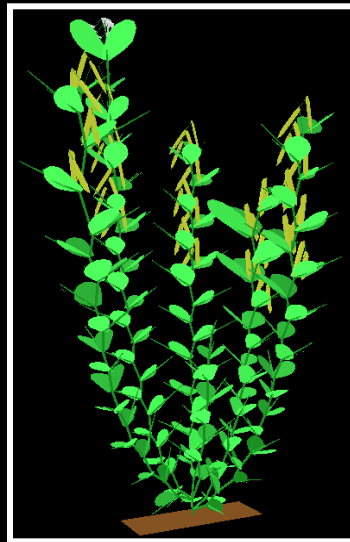
- Object – oriented: information (age, length, PAR...) stored within organs (object)
 - Generates stands, mono- or pluri -varietal (% of each genotypes)
 - Mono- or pluri -specific (wheat – pea mixtures)
 - Stands result from the population variability (\neq of a mean plant)
-
- Coupled with disease models in mono or plurispecific stands
 - Ideotype construction



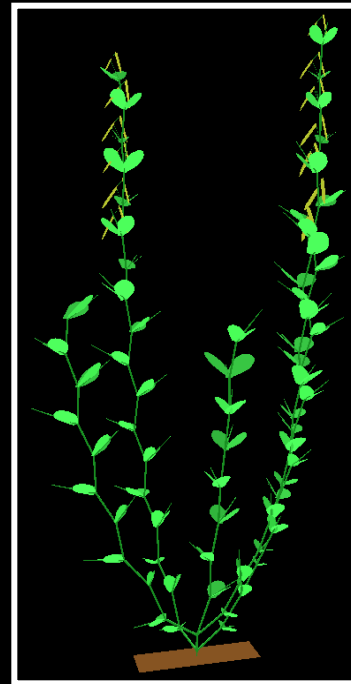
Semi-leafless



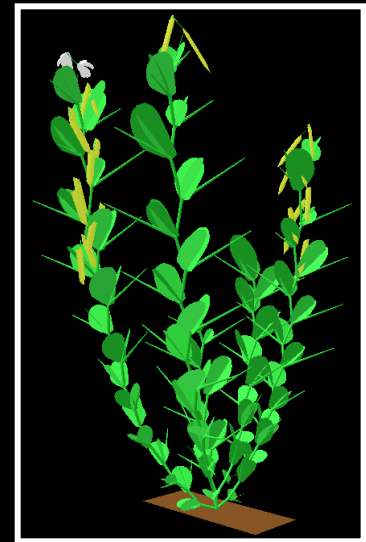
Leafy



High branching

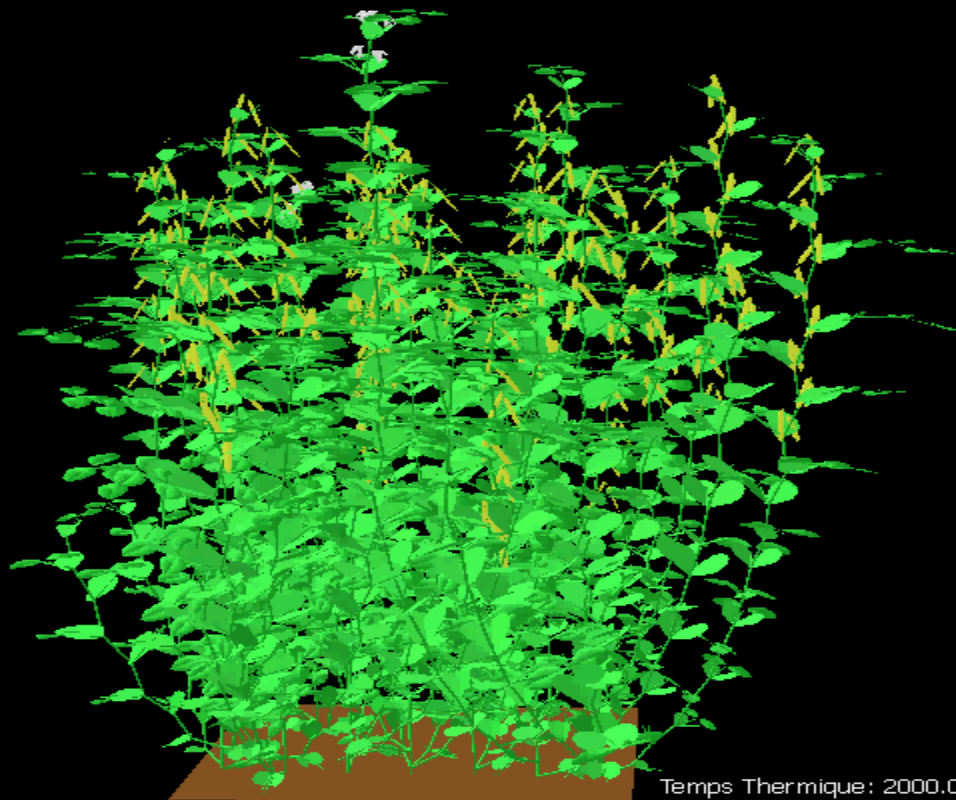


Long internode



Stipule inclination

Thank you for your attention



Temps Thermique: 2000.0 Degré(s) jour