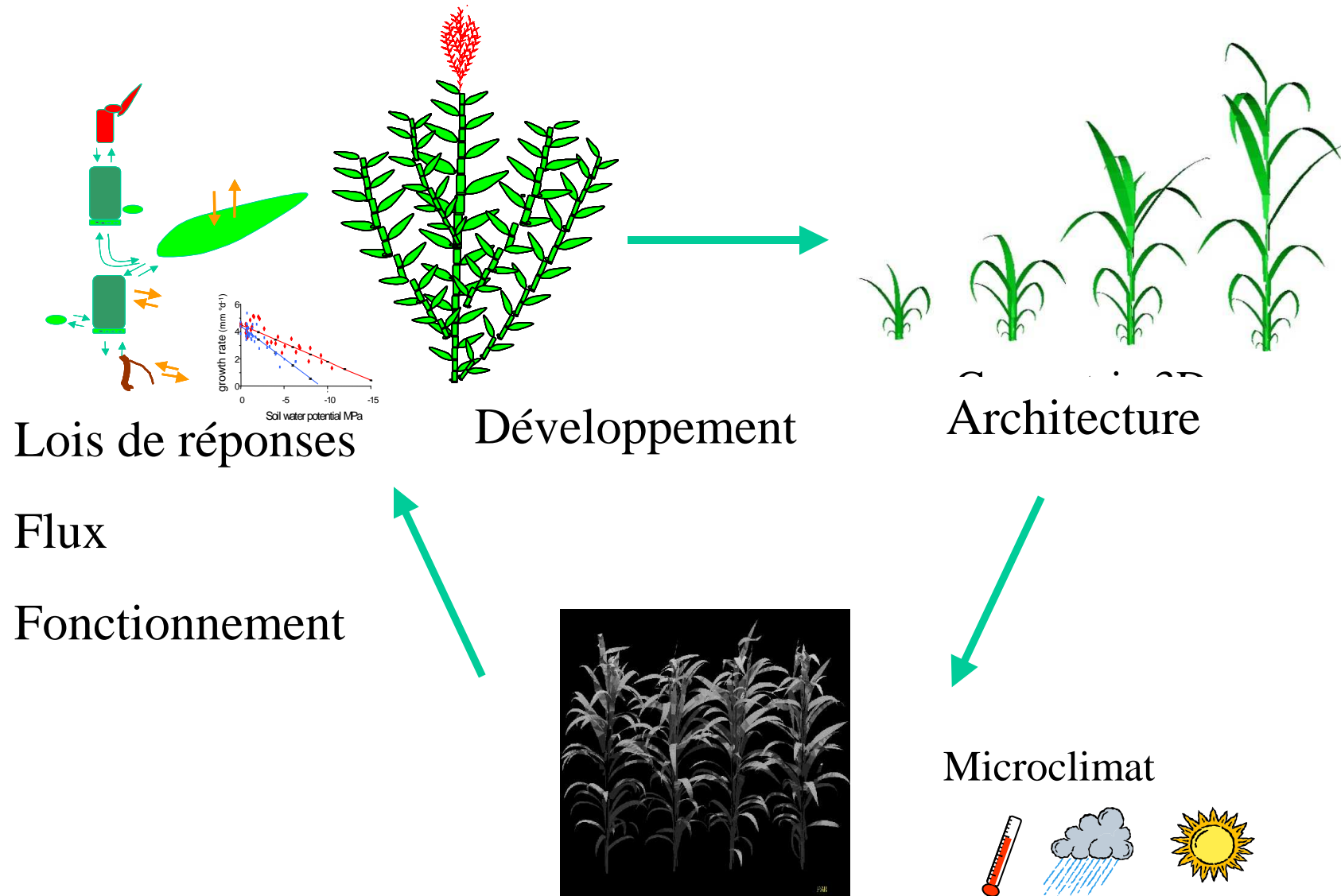


Que peut on attendre des modèles architecture/fonctionnement (FSPM) pour la conception d'idéotype et le phénotypage ?

C. Fournier

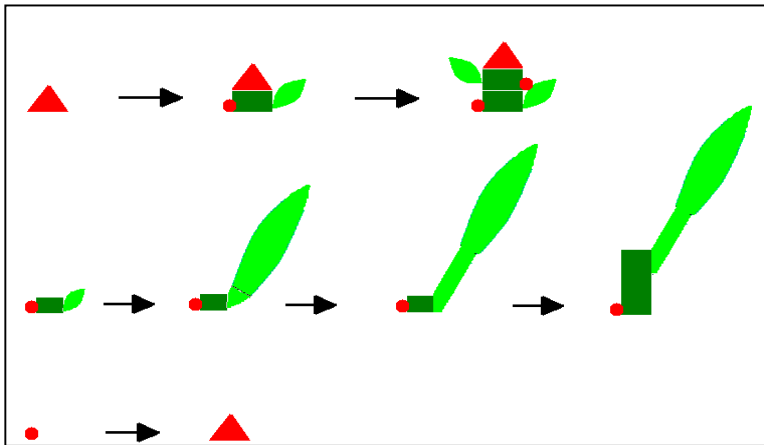


Approche plante virtuelle



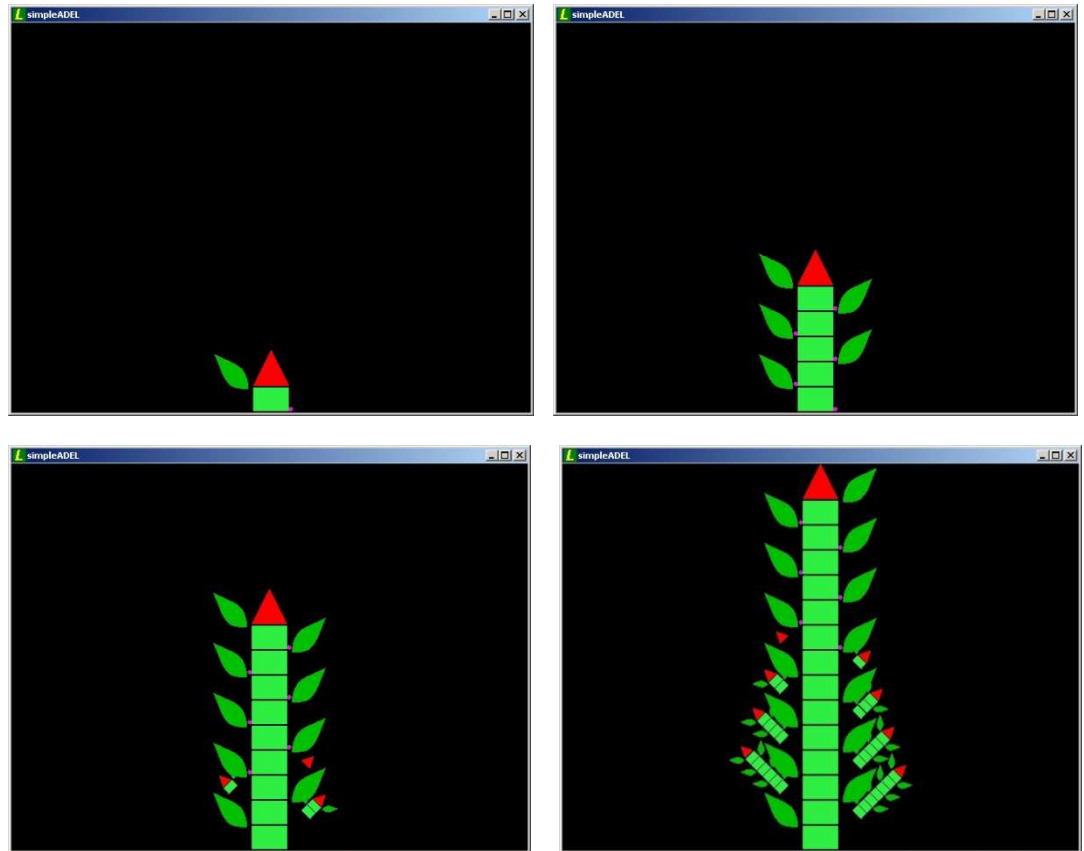
Simulation du développement

Modèle



Activités des méristèmes

Simulation

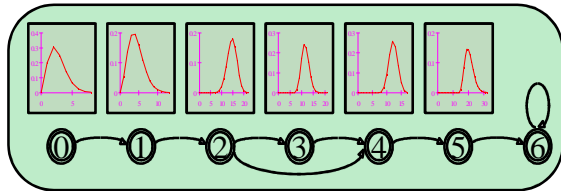
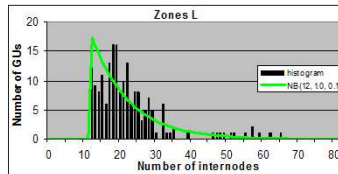
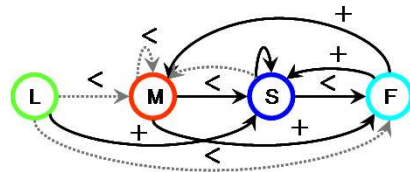


Séquence spatialisée d'évènements

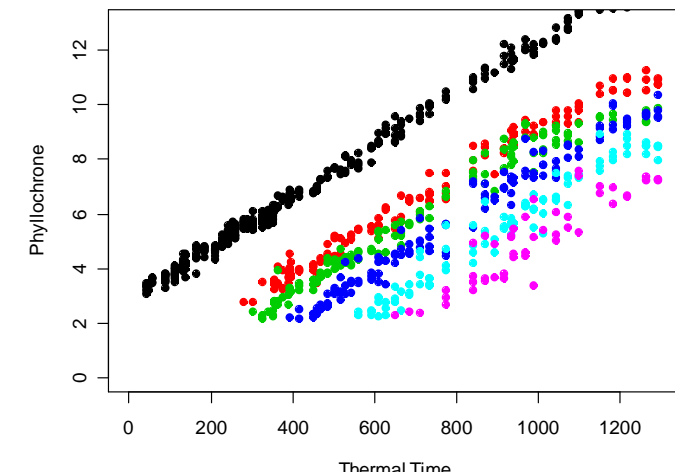
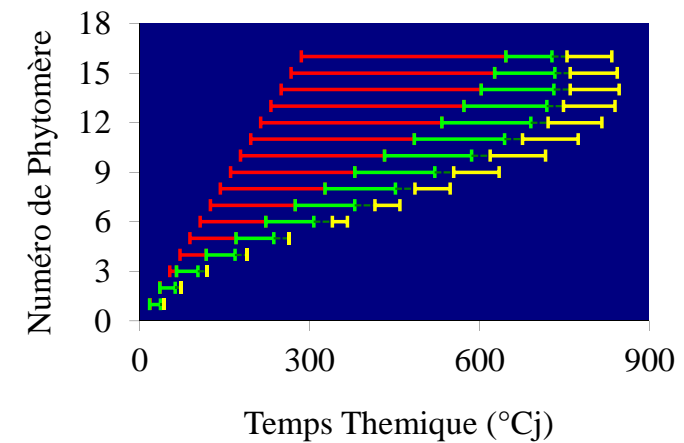
Paramétrisation des séquences (1)

Automates

stochastiques (Guédon,
Costes, Durand et al)



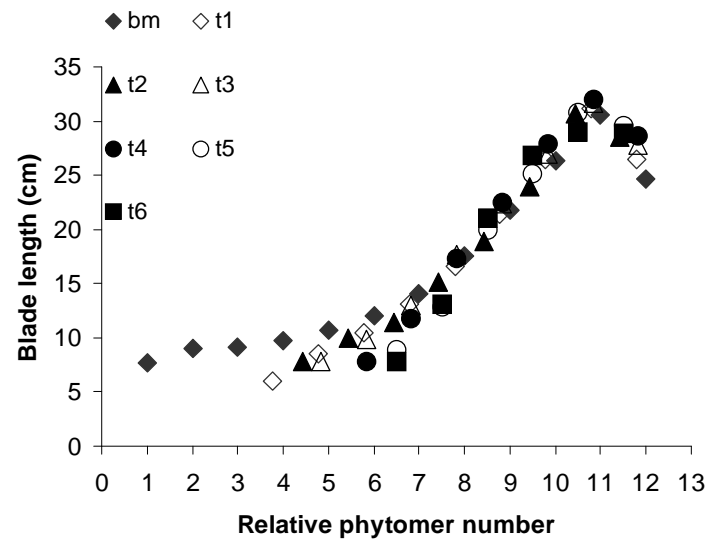
Calendriers déterministes (Fournier, Andrieu, Tardieu...)



Paramétrisation des séquences (2)

Profils (dimensions, vitesses, ...)

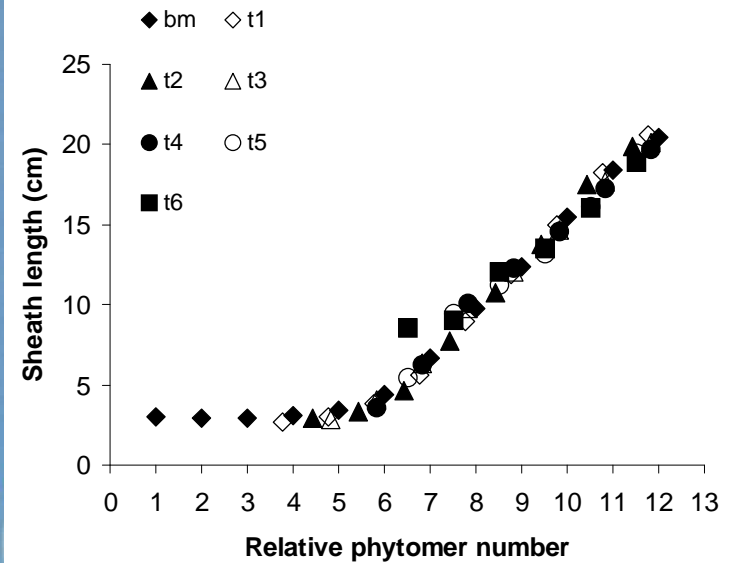
• Limbes



← Bas →
Haut

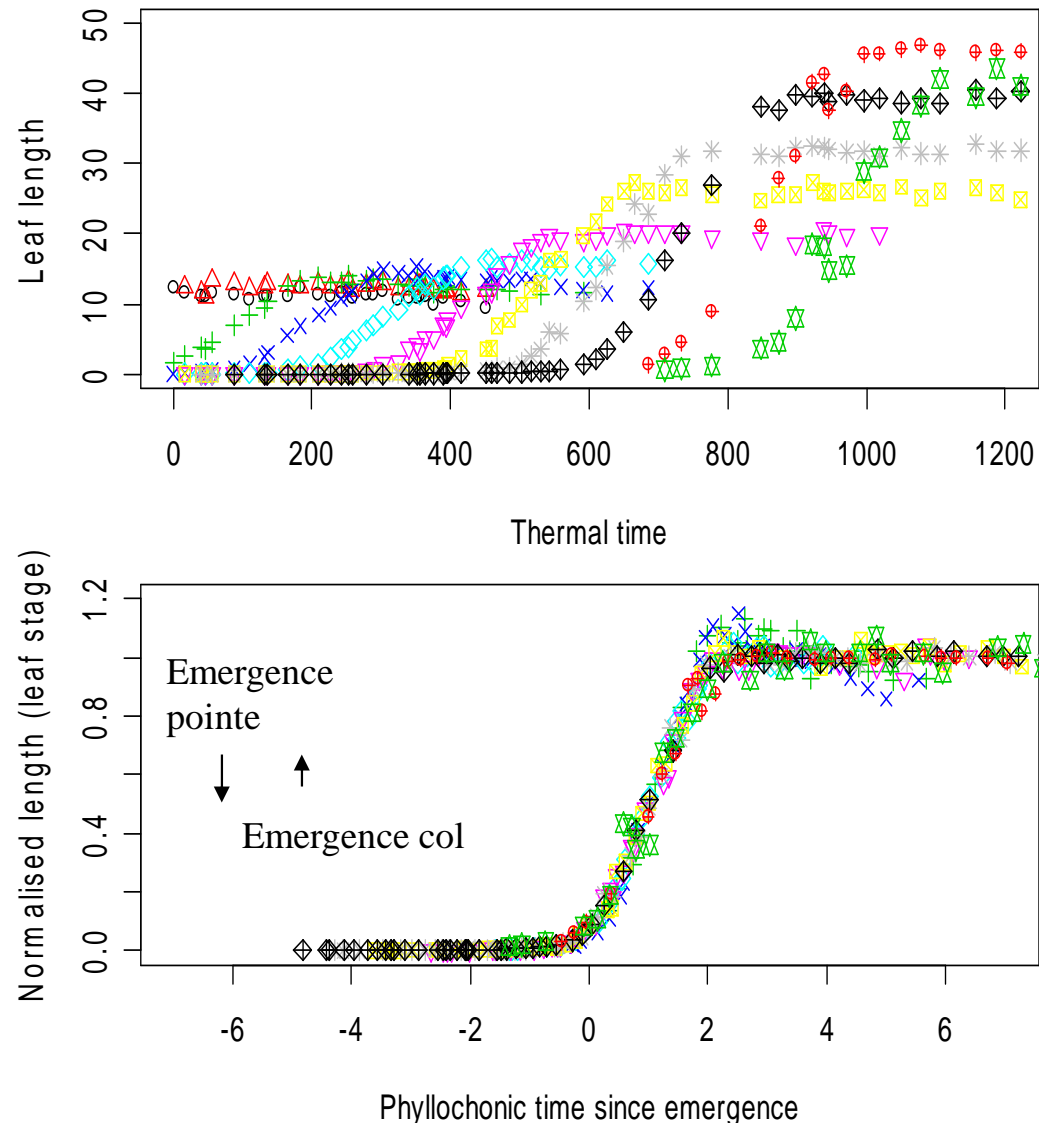


• Gaines (~tige)

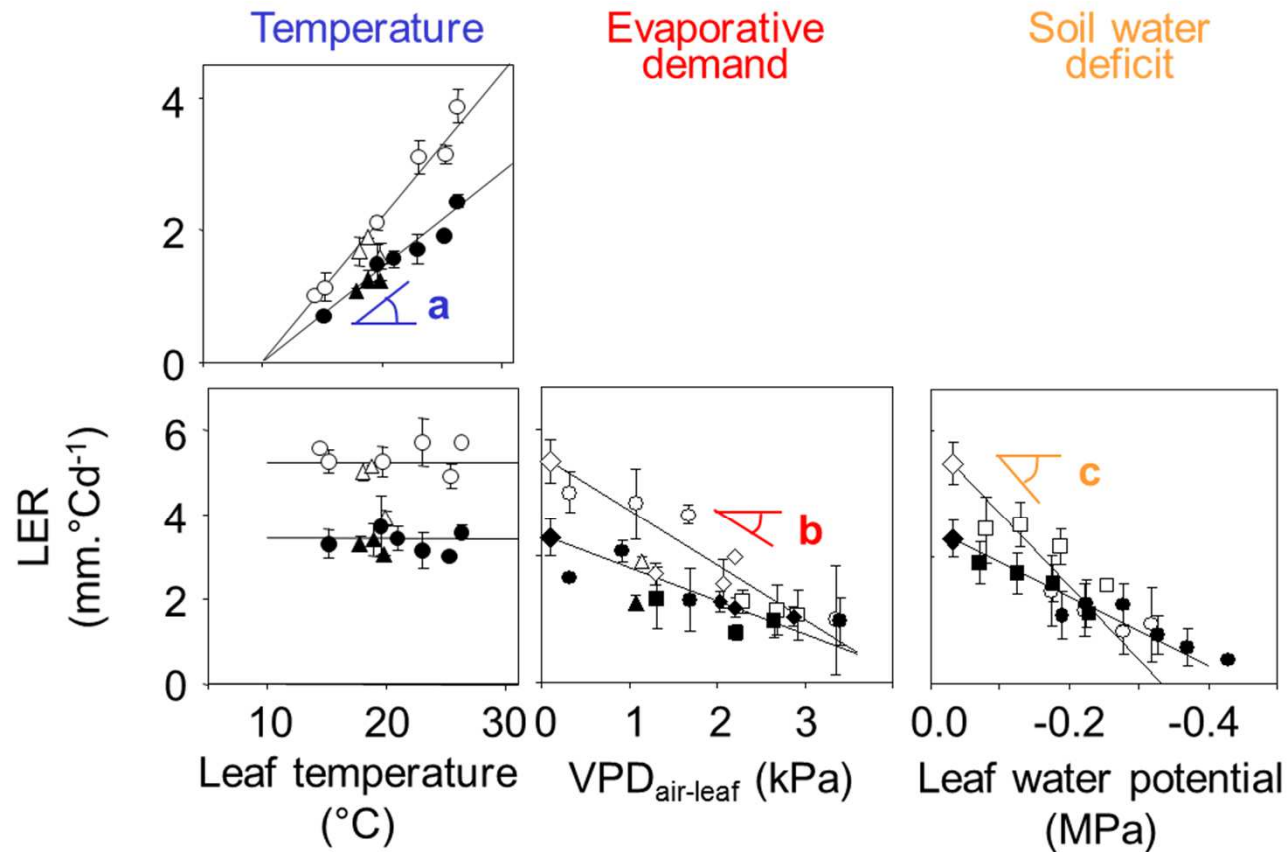


Paramétrisation des séquences (3)

courbes paramétriques

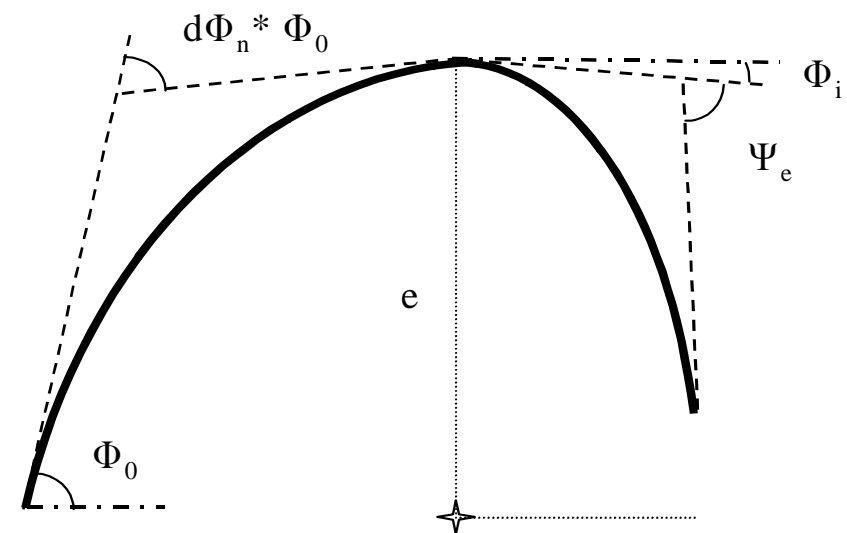
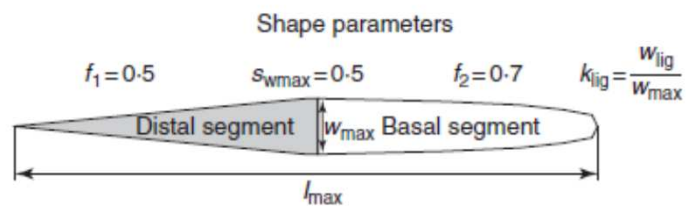
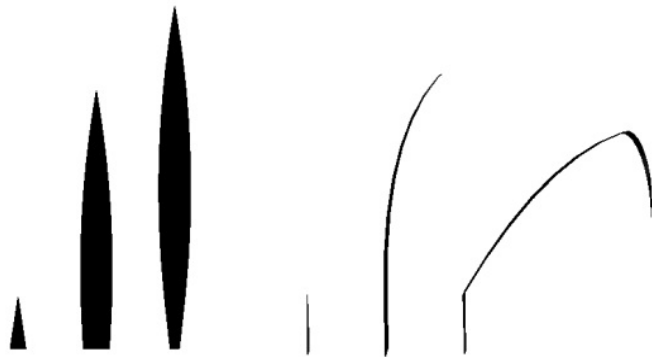
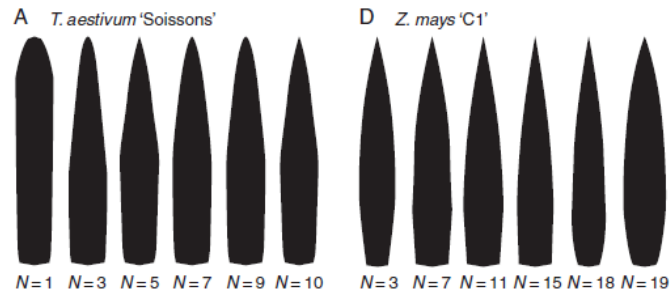


Responses to environment



For each genotype: $LER = dl/dt = (T - T_0)(a + b VPD_{air-leaf} + c \Psi)$

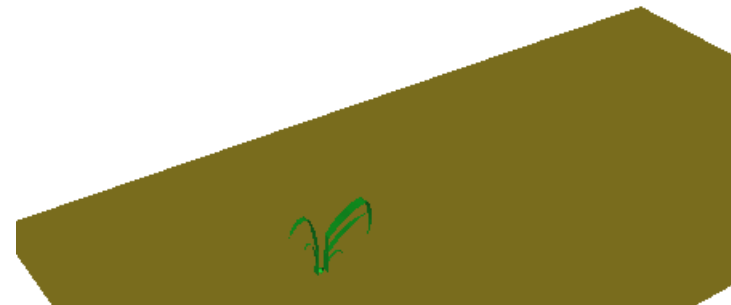
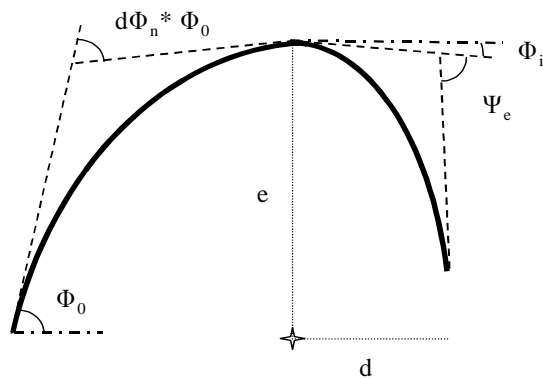
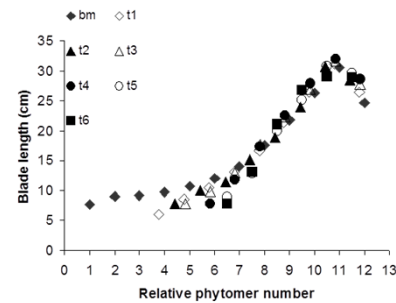
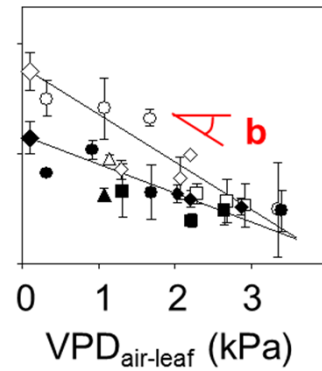
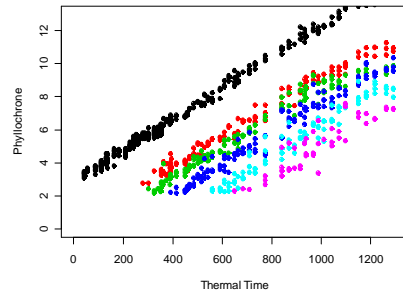
Modèle Géométrique



Assemblage

Modèle(s) + Paramètres (~100)

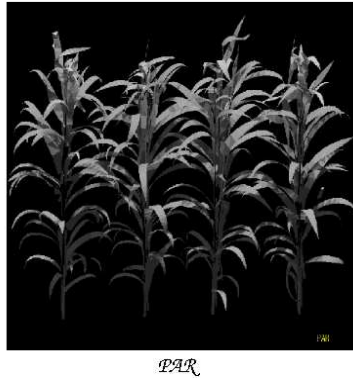
Simulation



Autres Simulations...

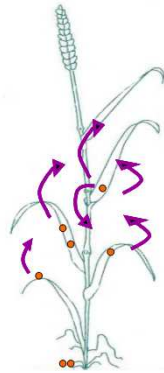
Light Microclimate

Caribu, RATP, Muslim, pydrops



Plant/Pathogens

M2A3PC, Septo3D

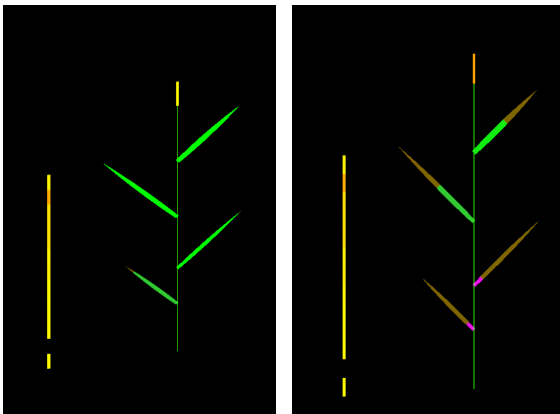


Morphogenesis/Plasticity

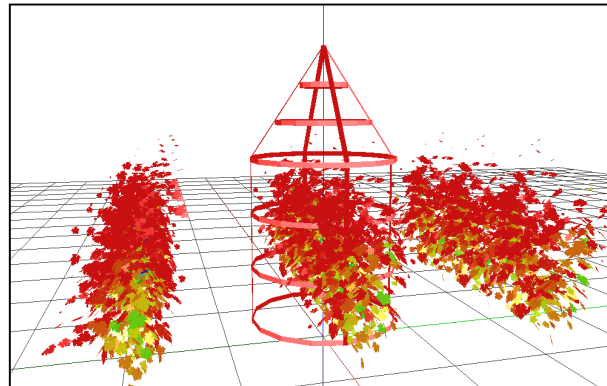
GrassLand, Virtual Rose, ADEL, Ecomeristem, MappleT



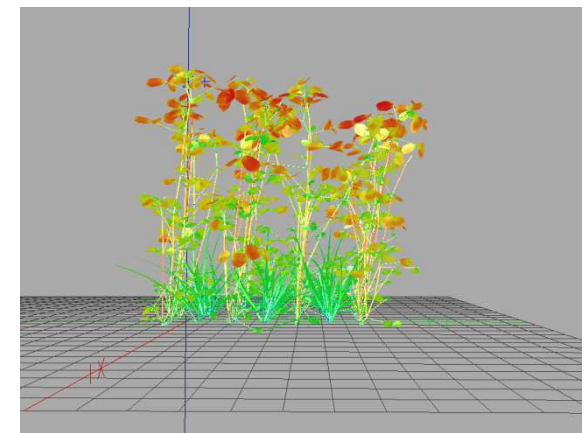
Plant functioning (N,C02)



Nema, Topvine



3D reconstruction



ADEL, PlantScan3D

Recherche d'ideotypes

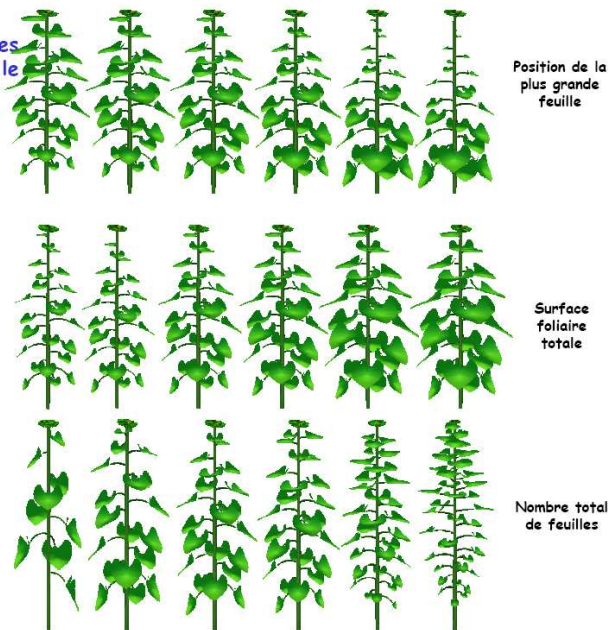
Variation paramètres architectures

Analyse virtuelle des conséquences de la plasticité phnéotypique chez le tournesol.

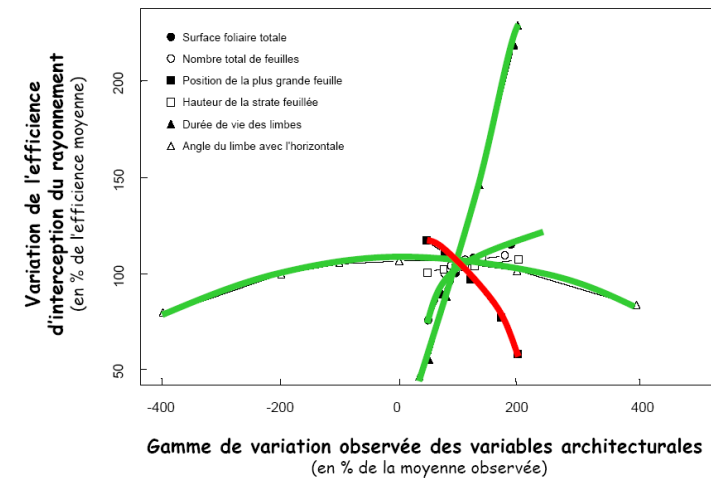


Plante virtuelle moyenne de référence

(d'après Casadebaig, 2004)

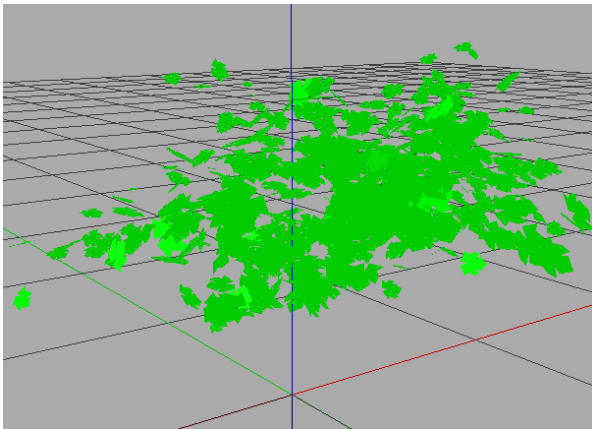


Simulation rayonnement



Evaluations/Ideotypes "fonctionnels" : Evaluation of the effect of plant architecture on WUE (Prieto PHD, 2008-2010)

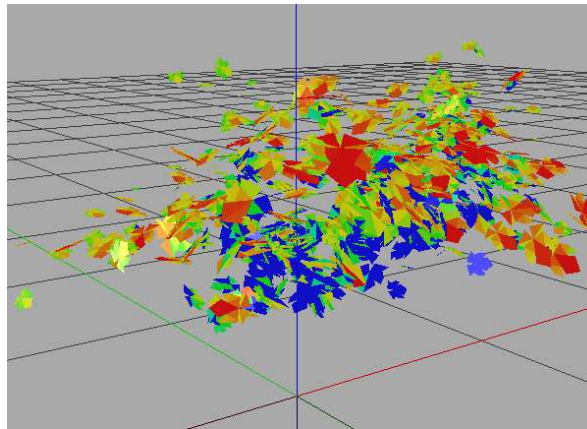
Topvine (Louarn et al 2008)



3D reconstruction



Caribu (Chelle et Andrieu 1998)

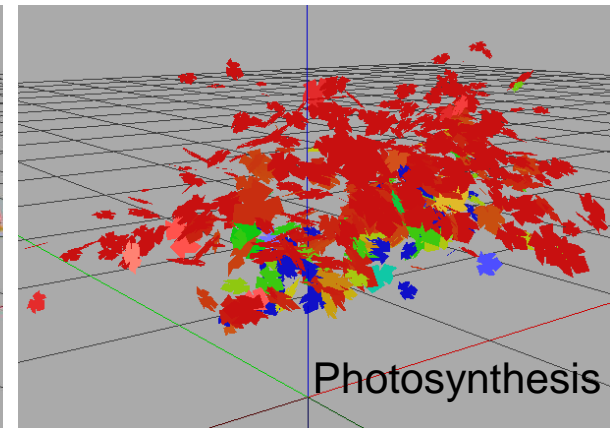


Light distribution

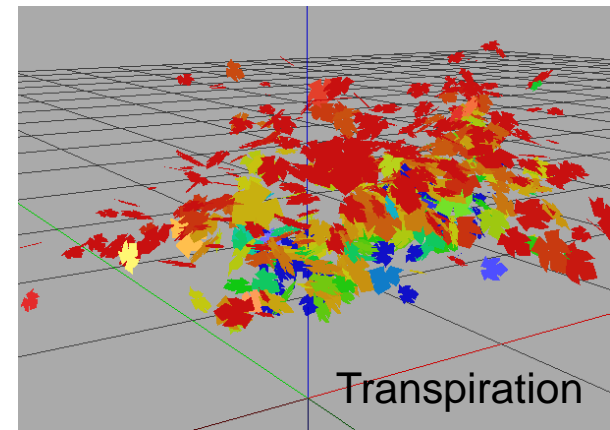


Gas exchange distribution

Gas exchange (Prieto et al np)

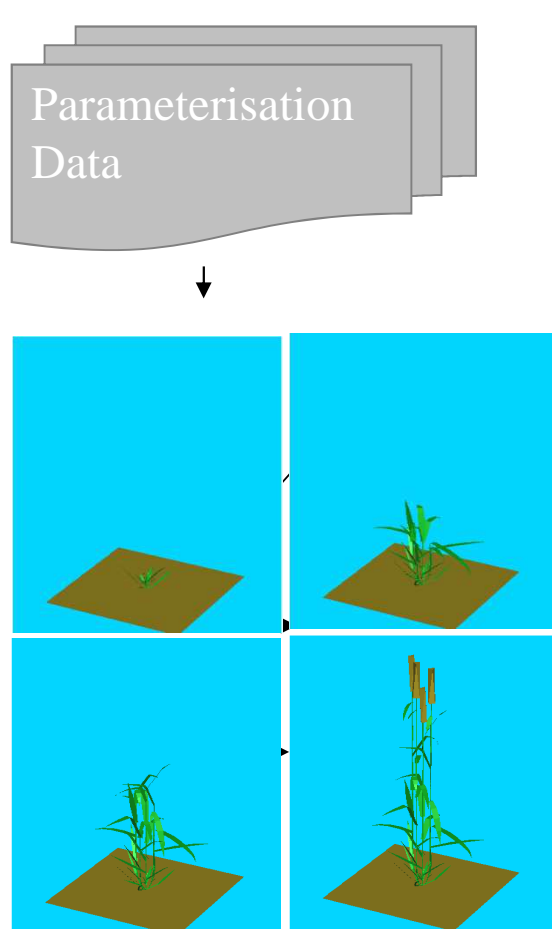


Photosynthesis

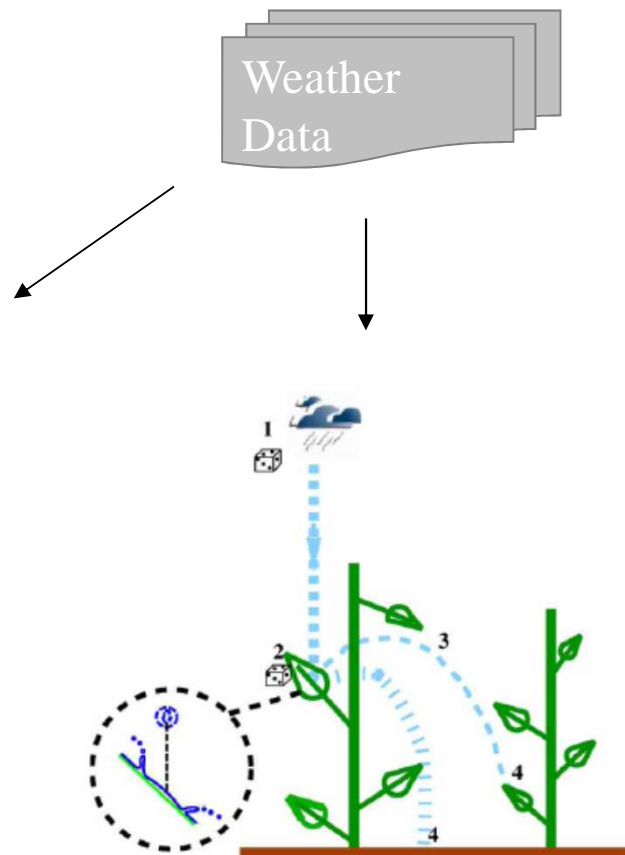


Transpiration

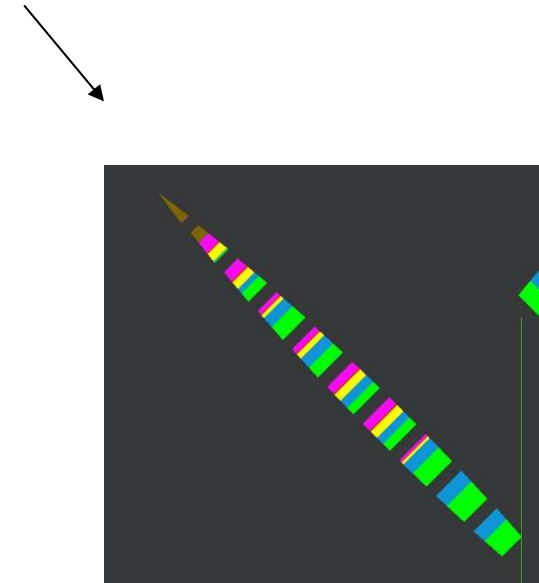
analyse des effet de l'architecture sur les épidémies foliaires



ADEL : 3D reconstructions
Position des lésions



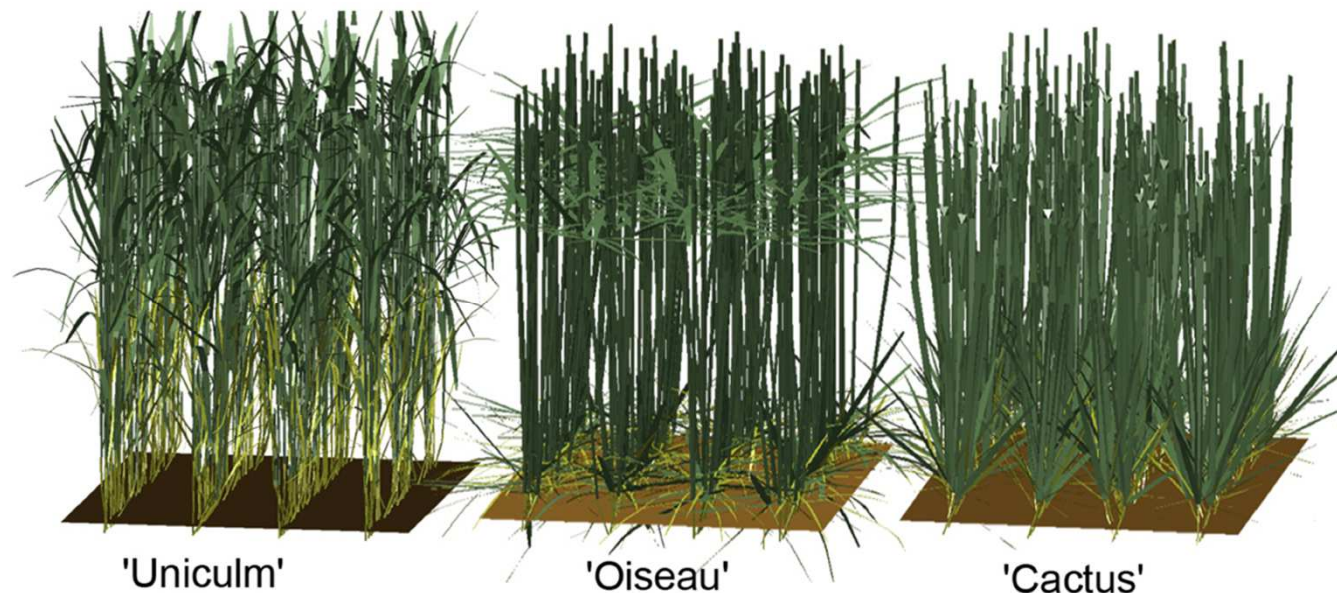
Dispersion



Cycle
Infectieux

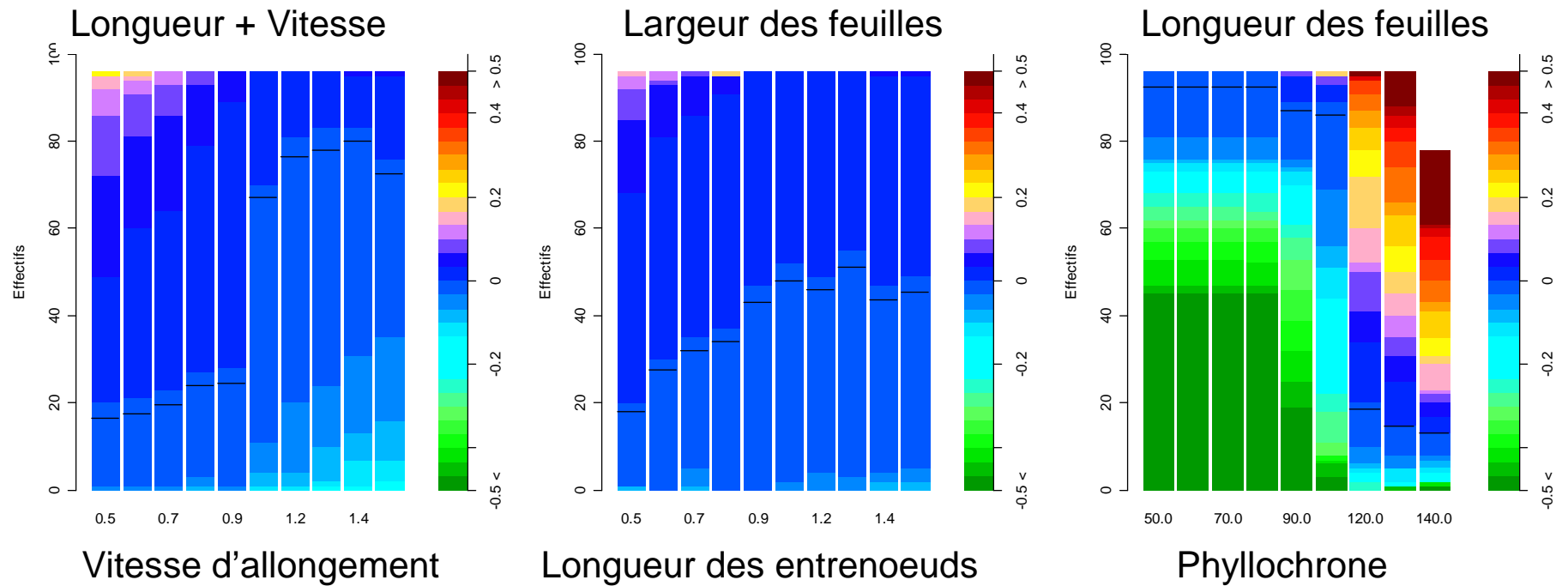
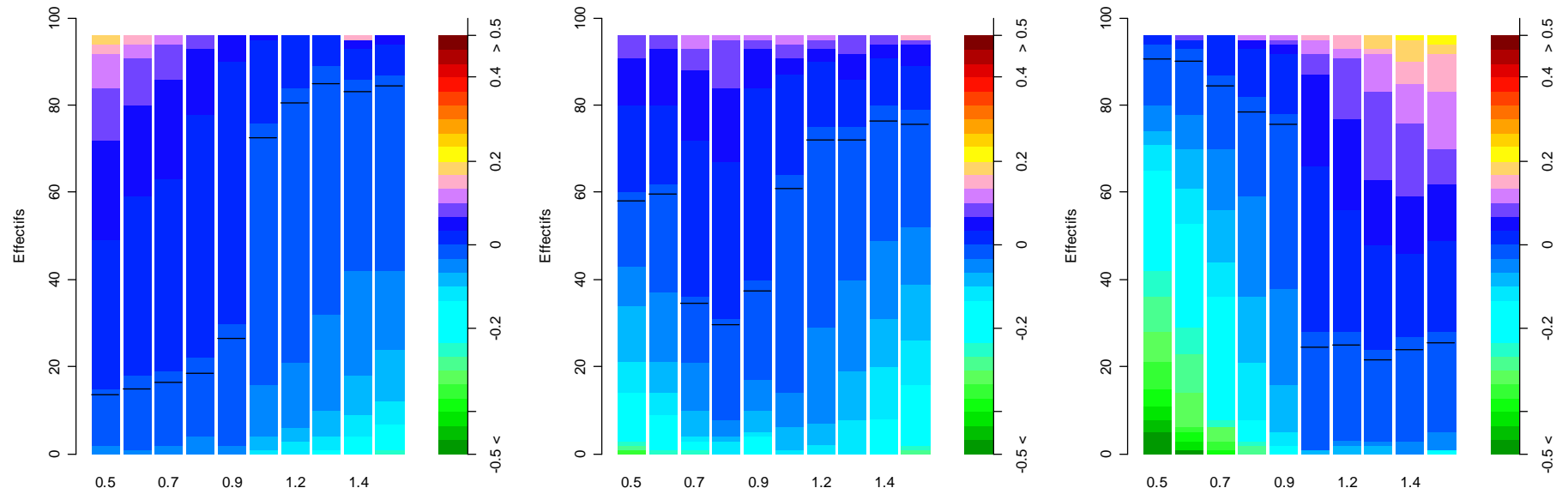
Robert et al, 2008

Recherche d'ideotypes multi-critère

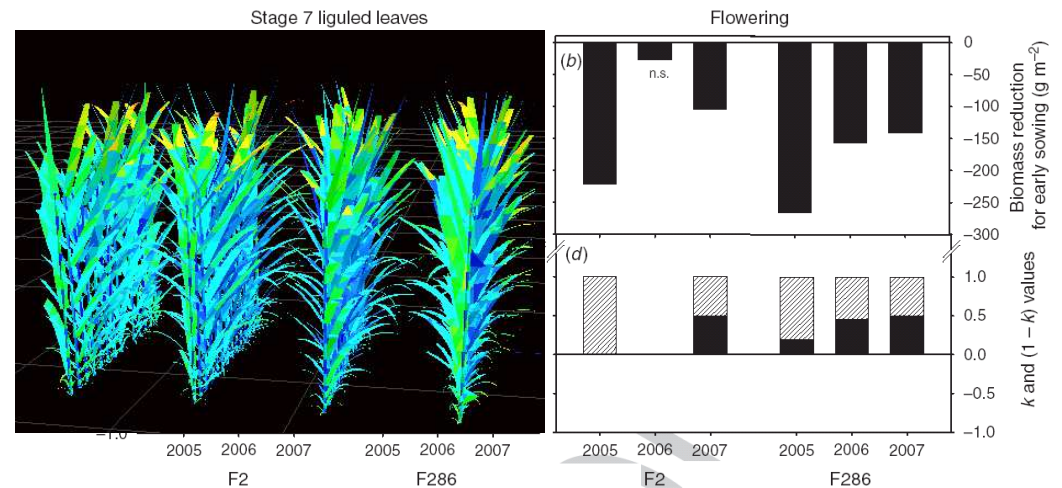
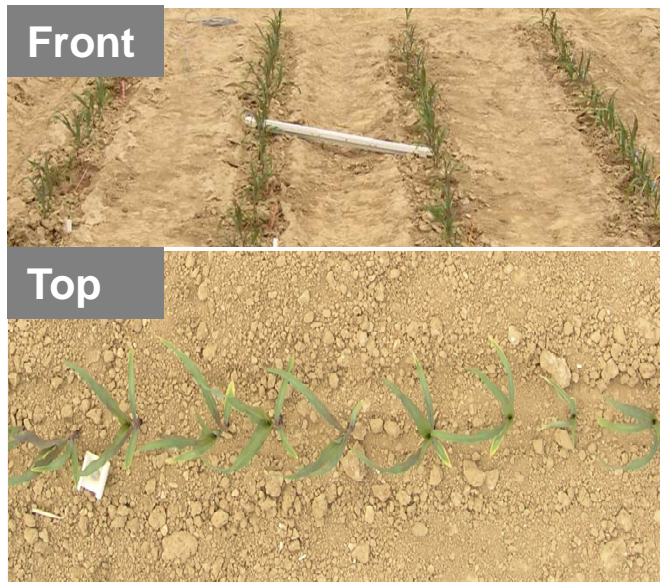
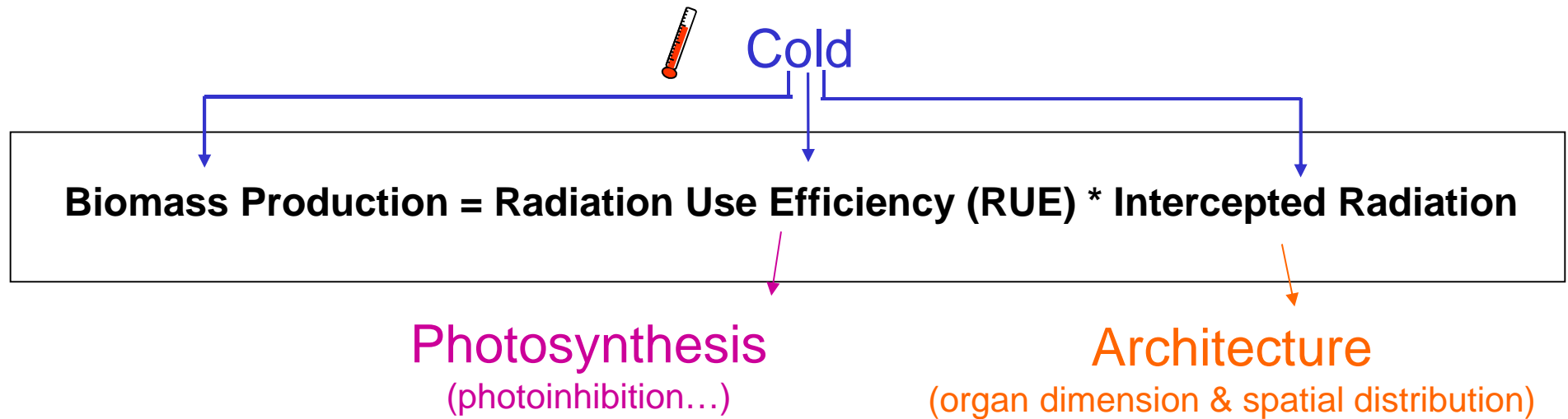


			Uniculu	Oiseau	Cactus	Soissons
Year 08-09	Diseased canopy	Disease severity all leaves (diseased surface, cm ²)	41,8	37,6	9	28,3
		Total Light intercepted (Green + Senescent tissues) (MJ/plante)	5,57	5,56	5,65	5,56
		Total Green Stem Light intercepted (MJ/Plante)	0,64	0,57	1,95	0,7
	Healthy canopy	Total Green (for yield)	2,51	3,42	2,71	3,38
		Yield estimate (q/ha)	48,77	66,49	52,76	65,7
		Total light intercepted by the ground (MJ/m ²)	476	331	444	340
Year 00-01	Diseased canopy	Disease severity all leaves (diseased surface, cm ²)	30,8	29,1	10,1	27,6
		Total Light intercepted (Green + Senescent tissues) (MJ/plante)	5,79	5,79	5,89	5,79
		Total Green Stem Light intercepted (MJ/Plante)	0,76	0,71	2,33	0,83
	Healthy canopy	Total Green (for yield)	2,97	3,94	3,18	4
		Yield estimate (q/ha)	57,68	76,55	61,8	77,78
		Total light intercepted by the ground (MJ/m ²)	432	279	397	270

Interaction avec le climat



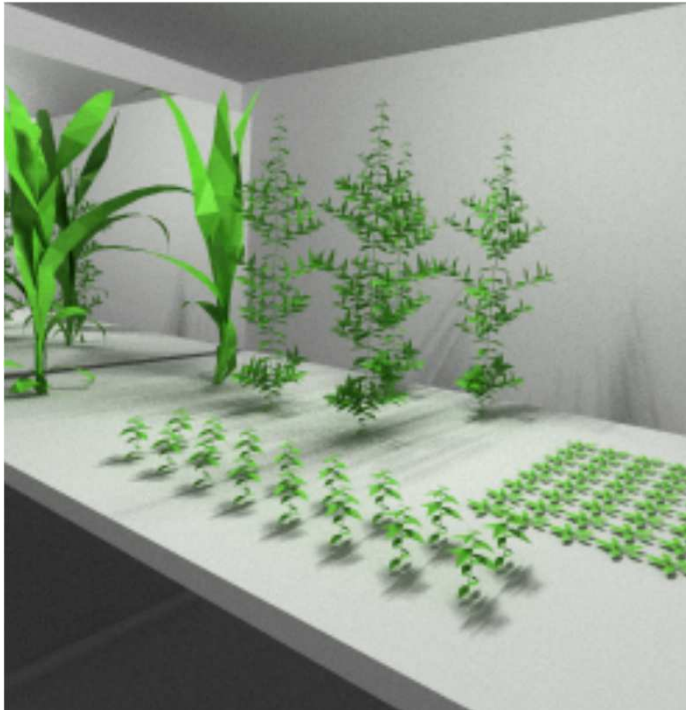
Phénotypage de variables 'cachées' (1)



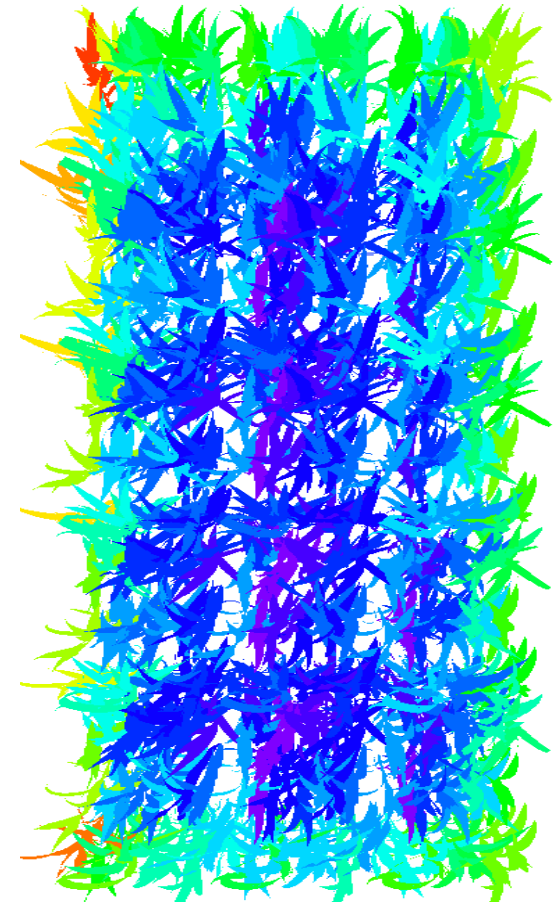
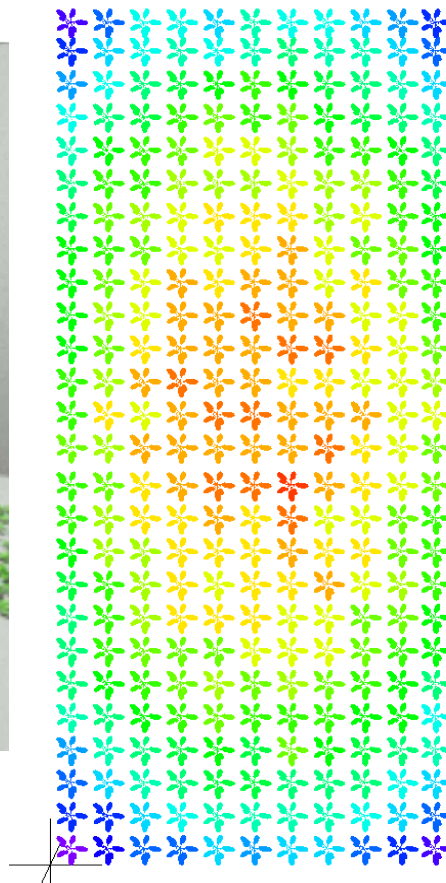
Louarn et al, 2008

Détermination de l'environnement ressenti

Convion



Maize & Strader



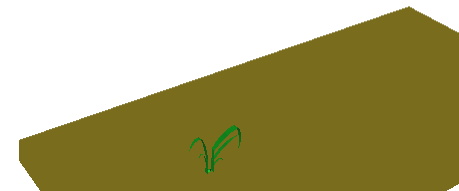
Chelle et al

Phenotyping architecture

PhenoArch Data

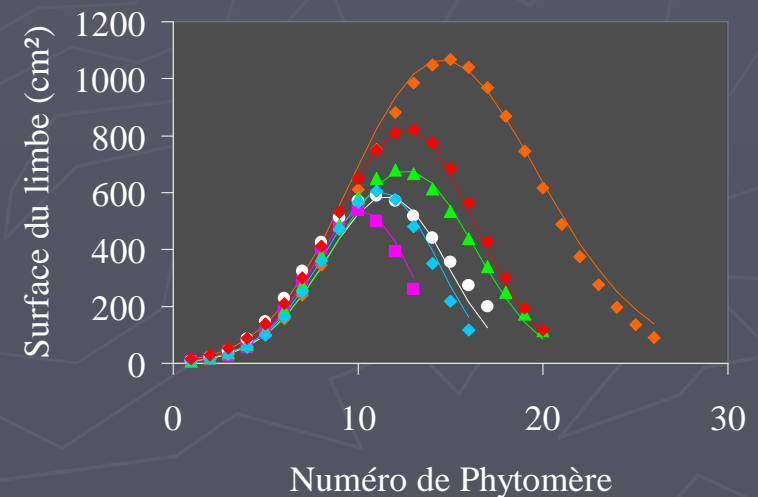
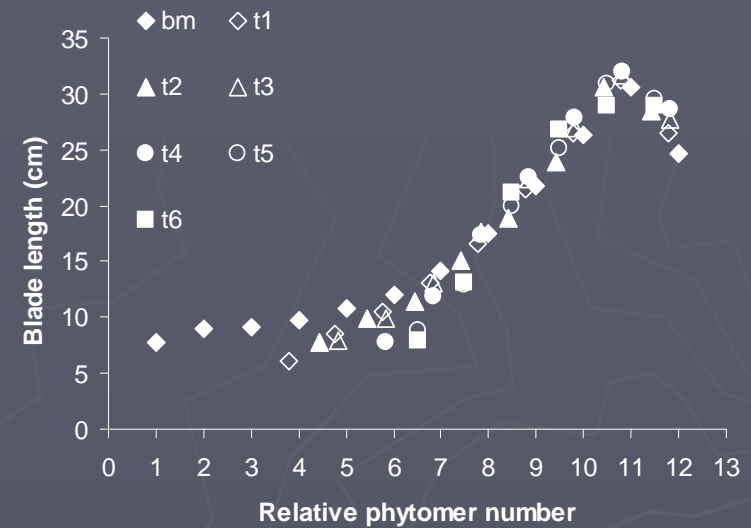
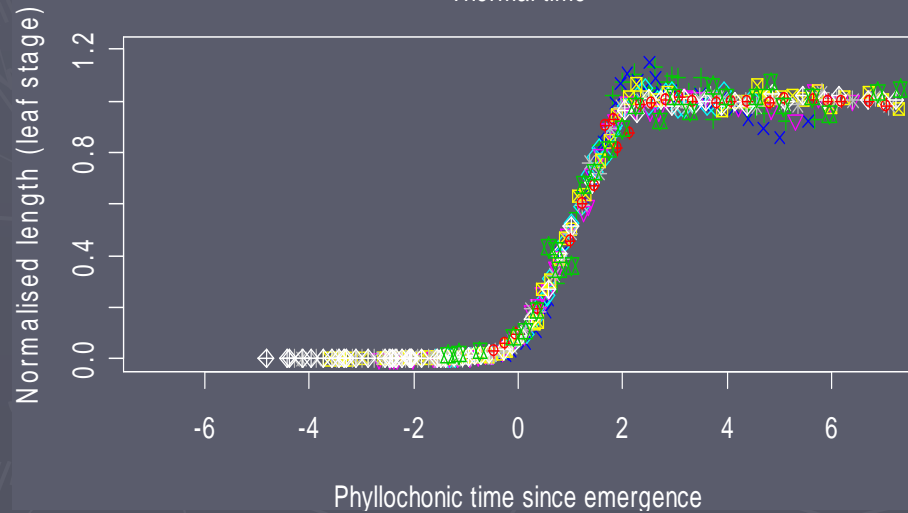
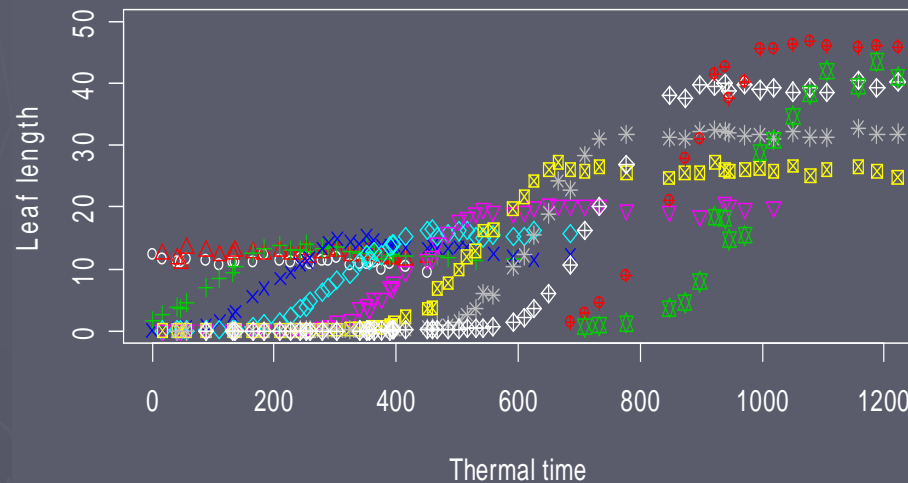


Model (ADEL)



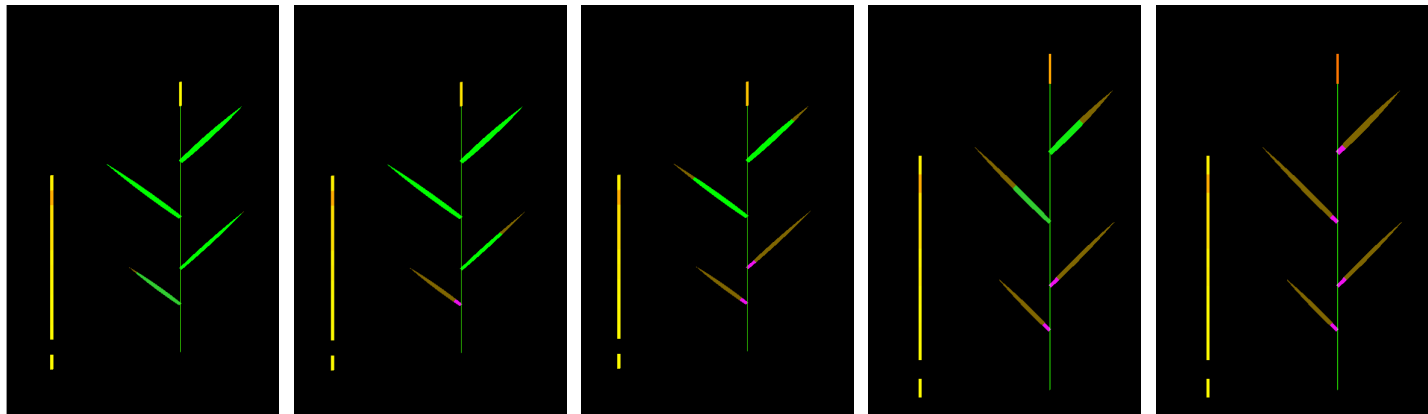
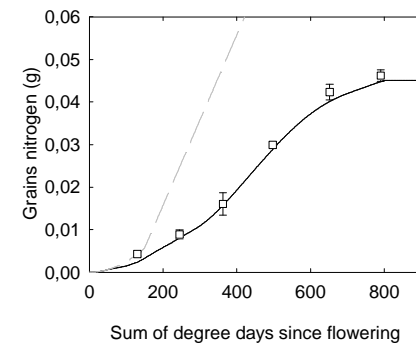
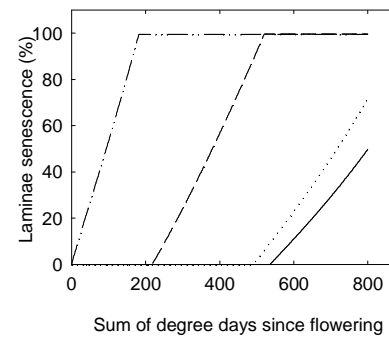
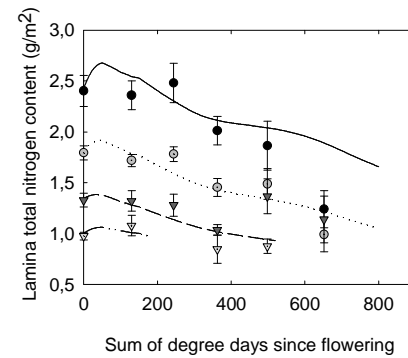
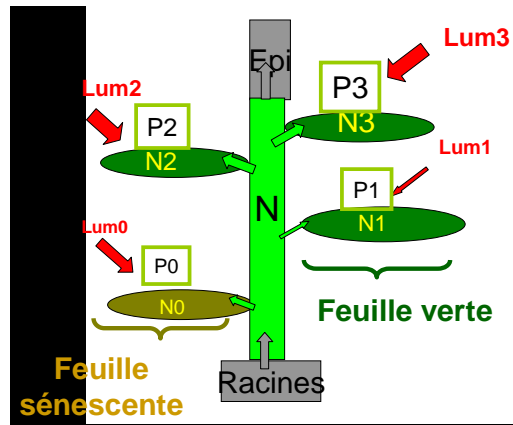
Réduction des paramétrisation (1)

Architecture



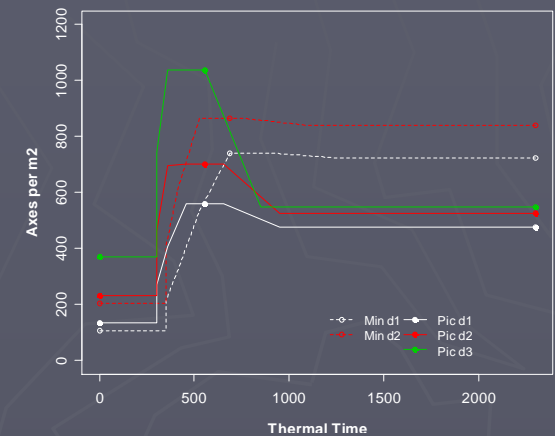
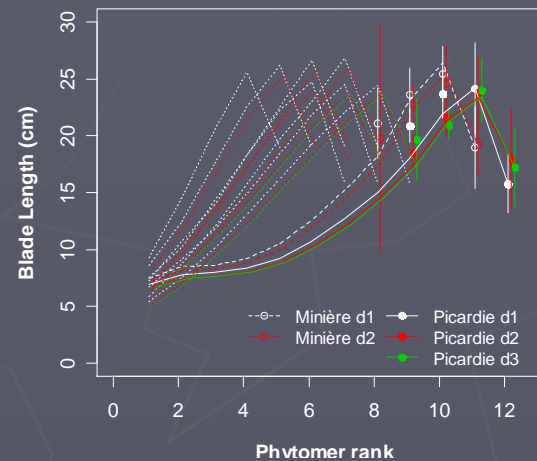
Reduction des paramétrisation(2) : fonctionel

J Bertheloot, C. Fournier, Pierre Martre

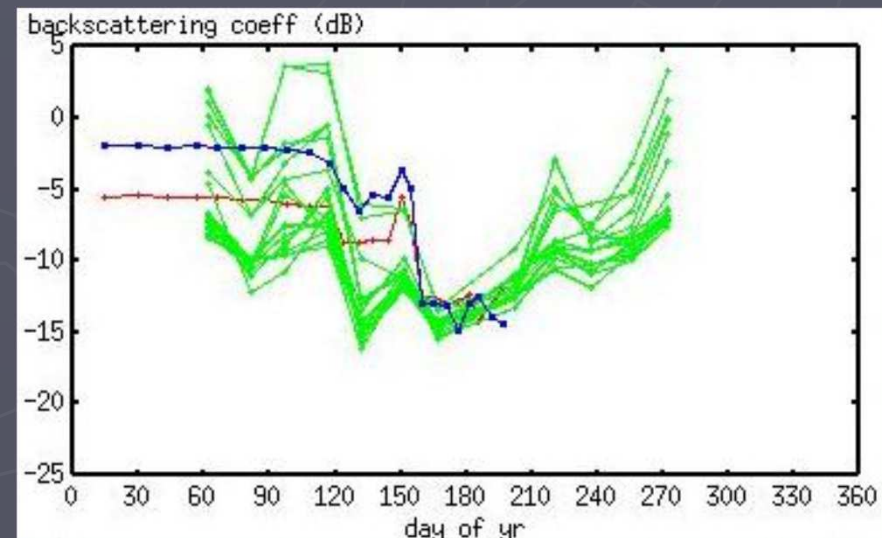


Application : Jeu de descripteur minimal pour caractériser le développement

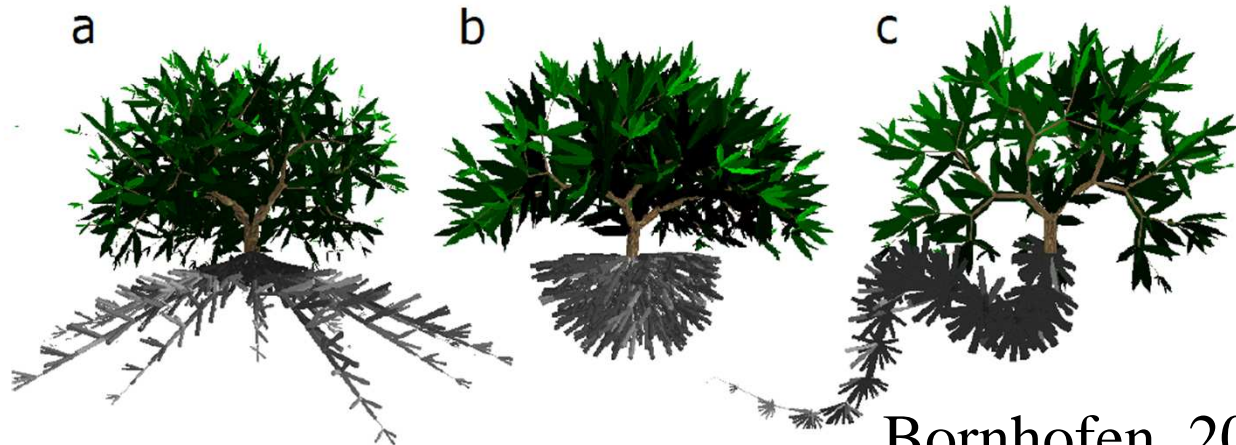
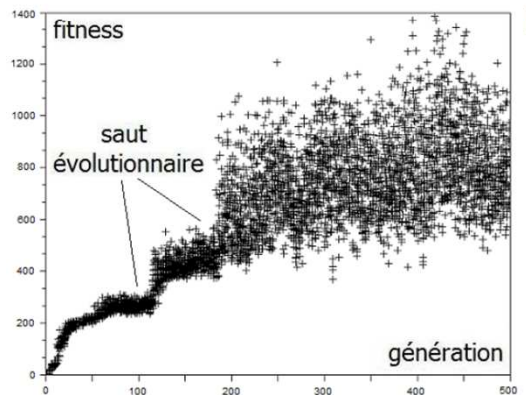
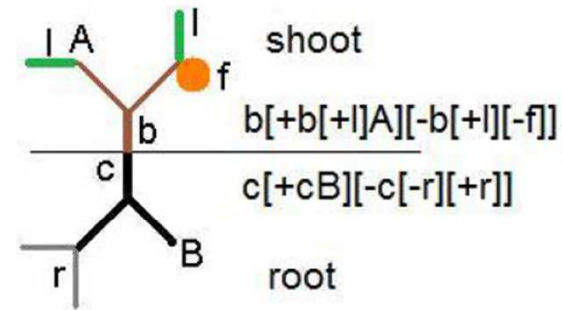
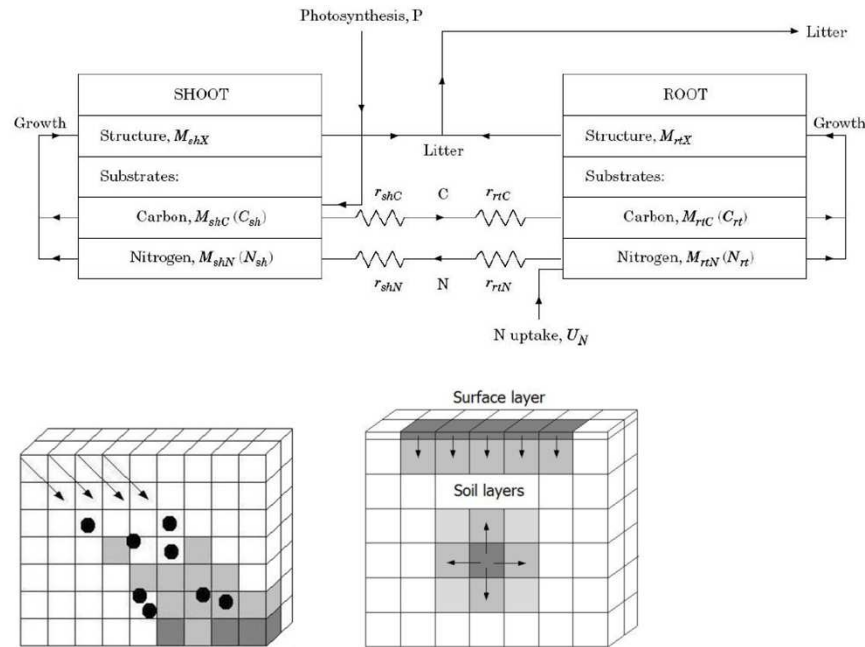
► Phénotypage de traits synthétiques



► Proxidétection / télédétection (utilisation de méthodes inverses)



Intégration haut niveau et évolution artificielle



Bornhofen, 2008

Conclusions

- **FSPM :**
- **Ideotypes architecturaux par simulation**
- **Intégration chaîne de Phénotypage : formalisation et variables cachées**
- **Reduction de modèles : définition de traits synthétiques**
- **Peu de modèles intégrés « multi fonction »**