



Biologie et
Architecture
des arbres

UN ARBRE, DES ARCHITECTURES



LES PLANTES PERÇOIVENT LEUR ENVIRONNEMENT

Forêt de Gryfino (Pologne)



400 pins plantés en 1930

Unifying model of shoot gravitropism reveals proprioception as a central feature of posture control in plants

Renaud Bastien^{a,b,c}, Tomas Bohr^d, Bruno Mouliat^{a,b,1,2}, and Stéphane Douady^{c,2}

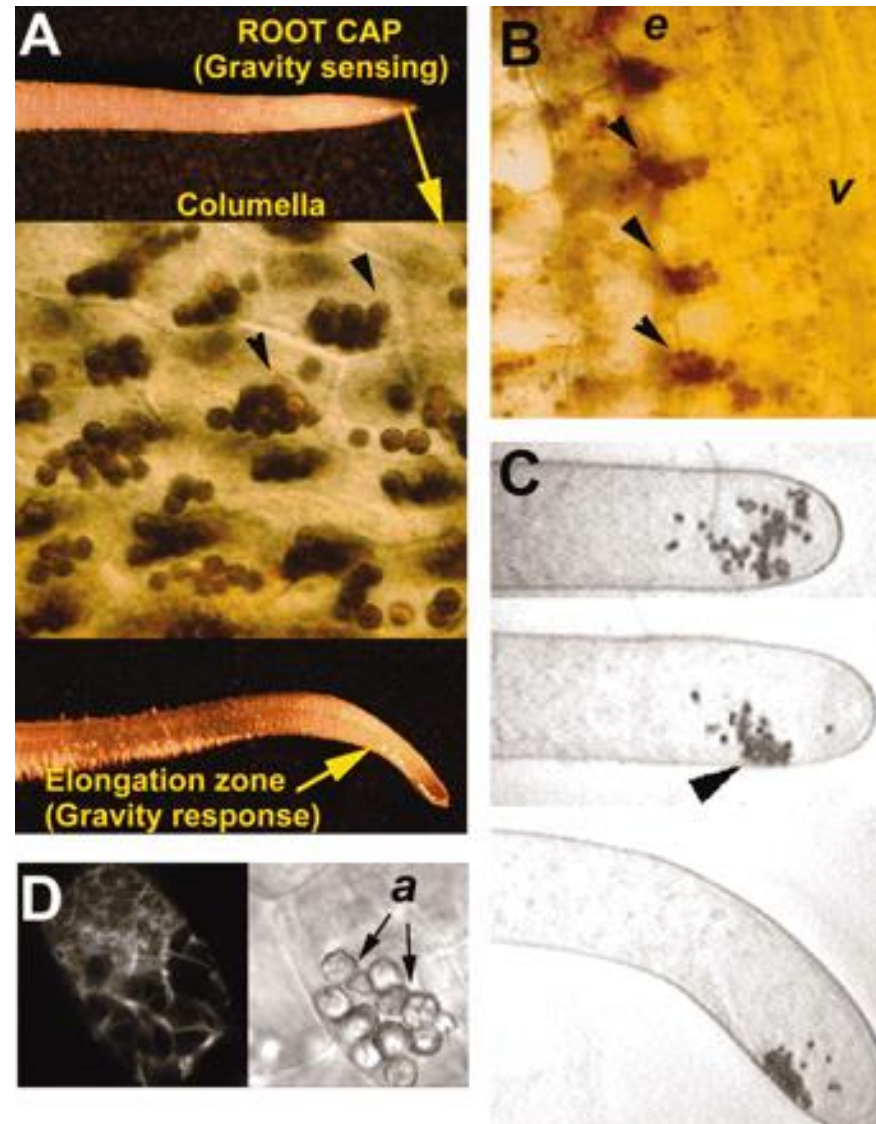
^aINRA (Institut National de la Recherche Agronomique), UMR0547 (Unité Mixte de Recherche PIAF Physique et Physiologie Intégratives de l'Arbre Fruitier et Forestier), F-63100 Clermont-Ferrand, France; ^bClermont Université, Université Blaise Pascal, UMR0547 (Unité Mixte de Recherche PIAF Physique et Physiologie Intégratives de l'Arbre Fruitier et Forestier), BP 10448, F-63000 Clermont-Ferrand, France; ^cMatière et Systèmes Complexes, Université Paris-Diderot, 75025 Paris Cedex 13, France; and ^dDepartment of Physics and Center for Fluid Dynamics, Technical University of Denmark, DK-2800 Lyngby, Denmark



Plant Gravitropism. Unraveling the Ups and Downs of a Complex Process¹

Elison B. Blancaflor and Patrick H. Masson*

Plant Biology Division, The Samuel Roberts Noble Foundation, 2510 Sam Noble Parkway, Ardmore, Oklahoma 73401 (E.B.B.); and Laboratory of Genetics, University of Wisconsin Madison, 445 Henry Mall, Madison, Wisconsin 53706 (P.H.M.)



LES PLANTES PERÇOIVENT LA GRAVITE, LEUR PORT



ET Y ADAPTENT LEUR DEVELOPPEMENT

LES PLANTES PERÇOIVENT LA LUMIÈRE :

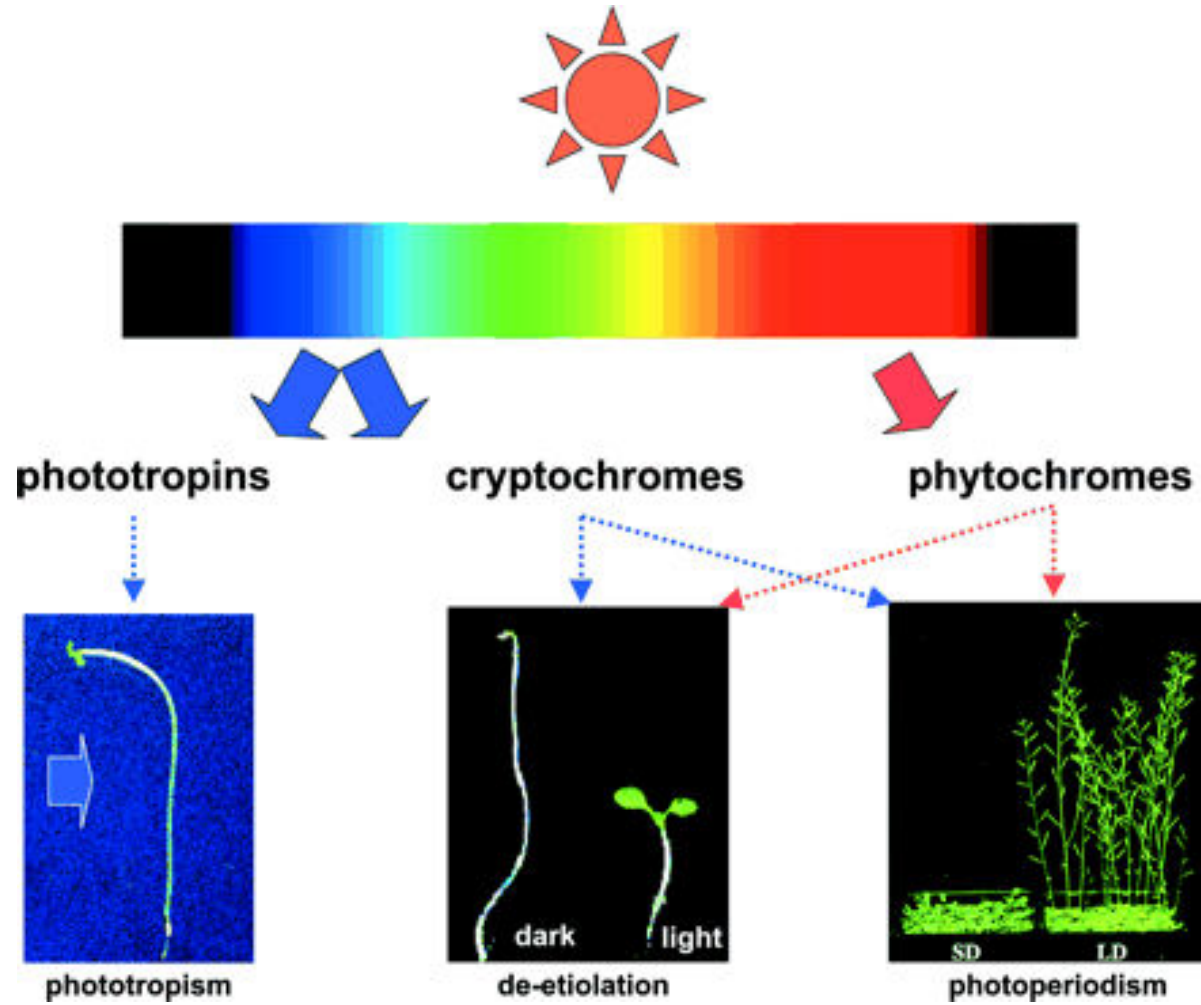


LE PHOTOROPISME

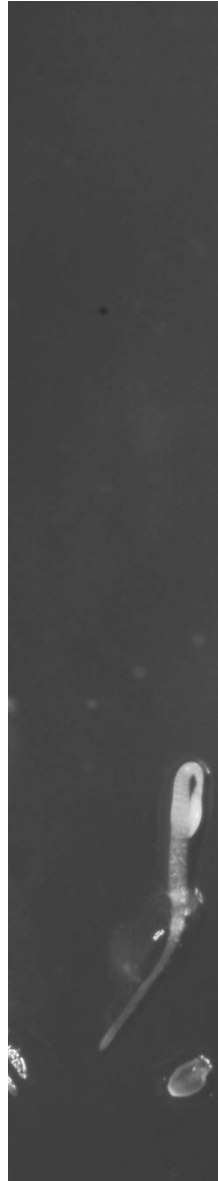
Blue Light Receptors and Signal Transduction

Chentao Lin¹

Department of Molecular, Cell and Developmental Biology University of California, Los Angeles, CA 90095

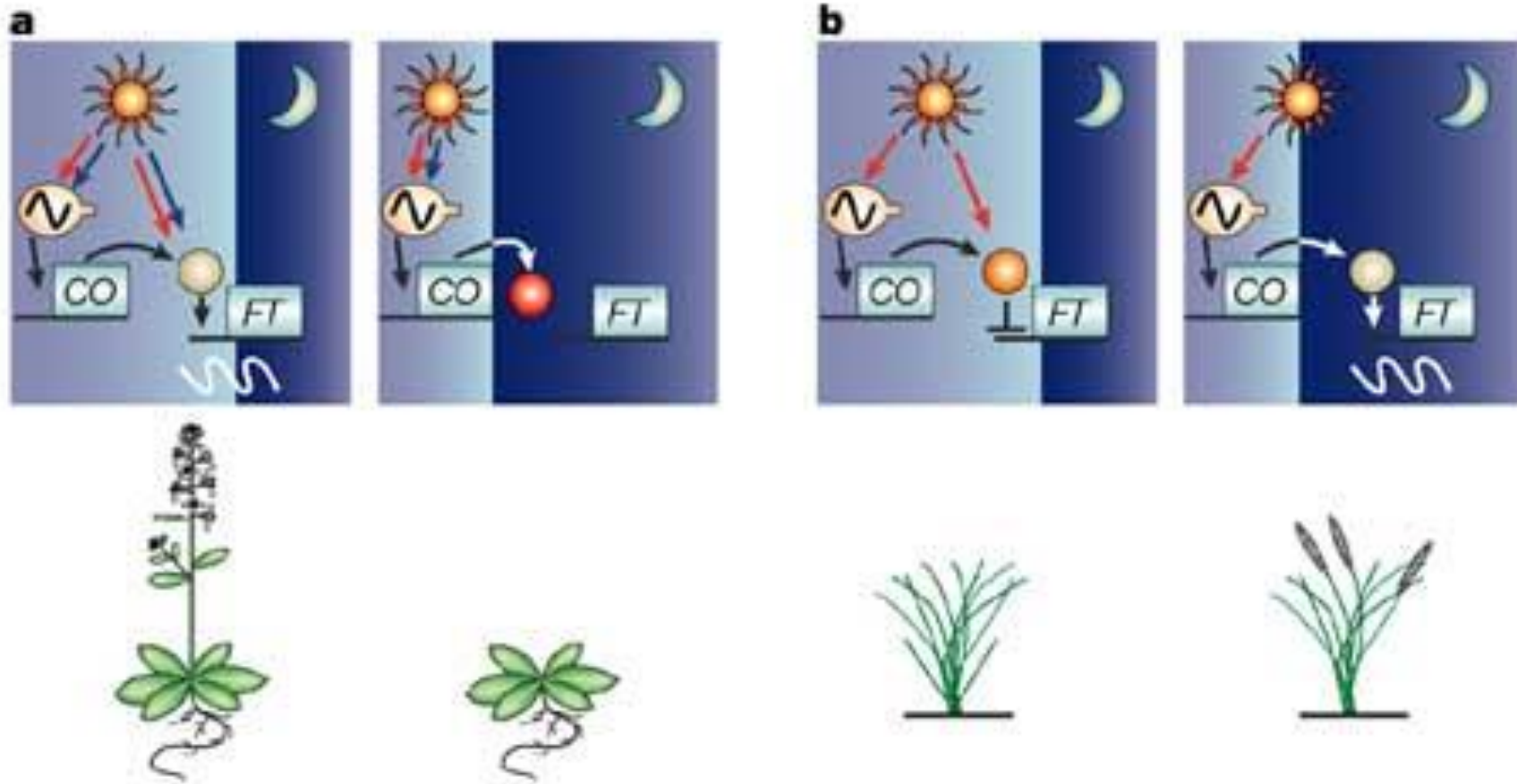


LES PLANTES PEUVENT SE DEVELOPPER DANS LE NOIR



LA SKOTOMORPHOGENESE

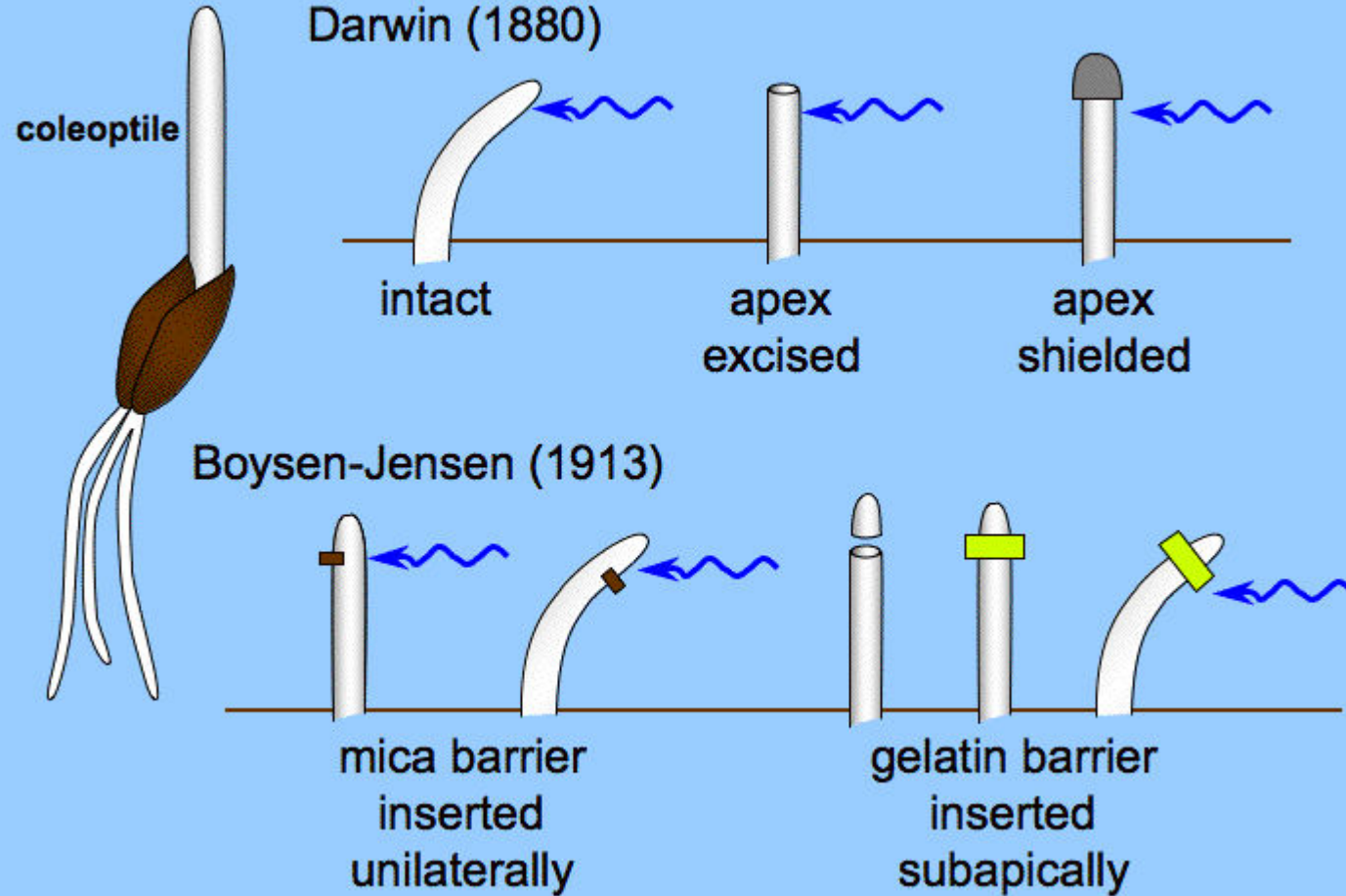
LES PLANTES PERCOIVENT LA LUMIERE



Nature Reviews | Molecular Cell Biology

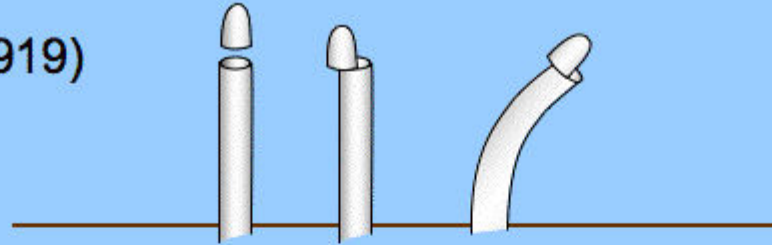
ET ADAPTENT LEUR DEVELOPPEMENT

Discovery of Auxin: Phototropic Response of Grass Seedlings



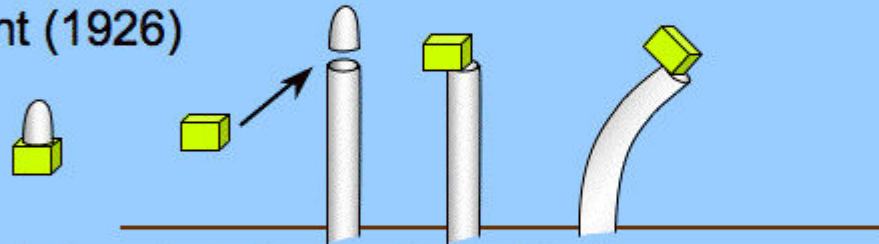
Discovery of Auxin: Tropic Response of Grass Seedlings

Paál (1919)

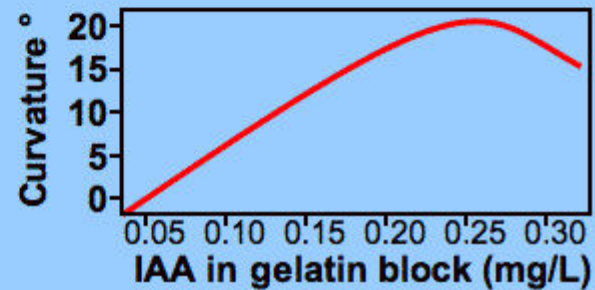


tip replaced off-center = curvature in dark

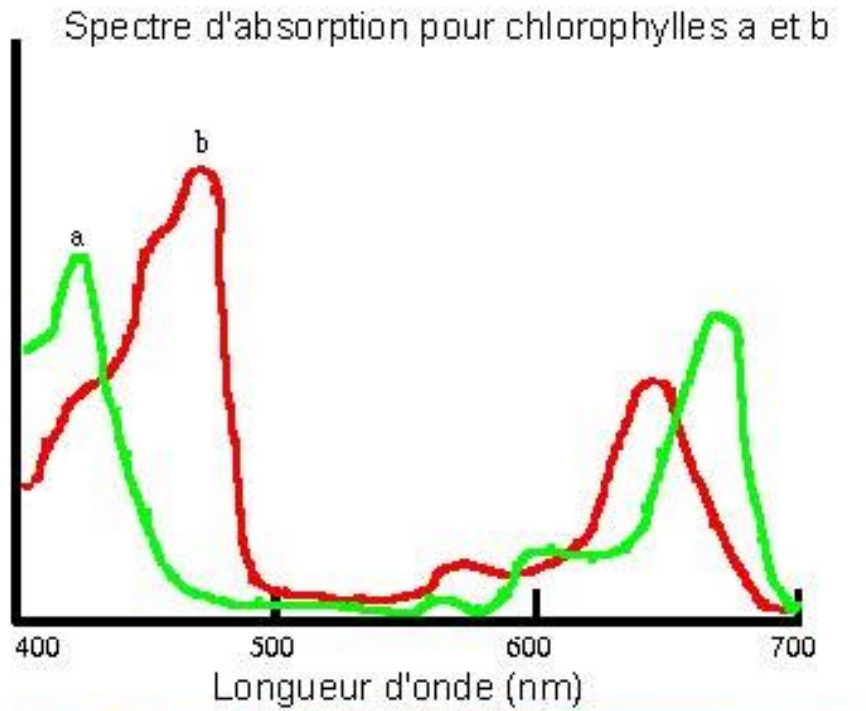
Went (1926)



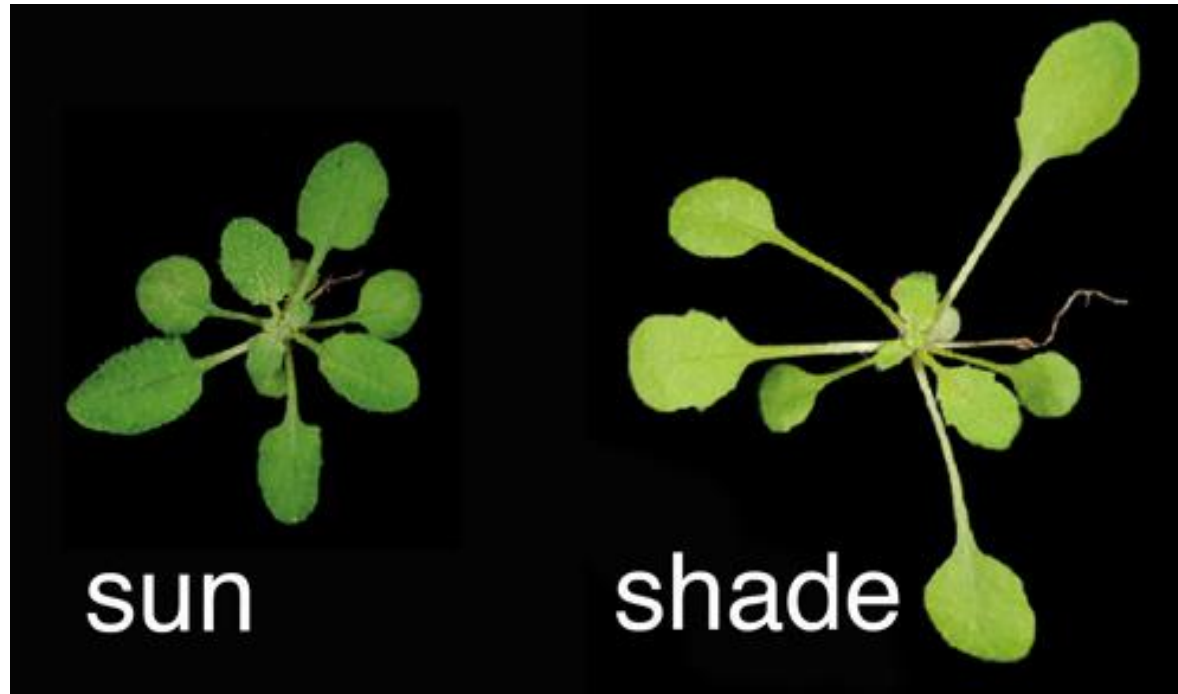
tip incubated on gelatin block
tip replaced by block, but off-center
curvature in dark



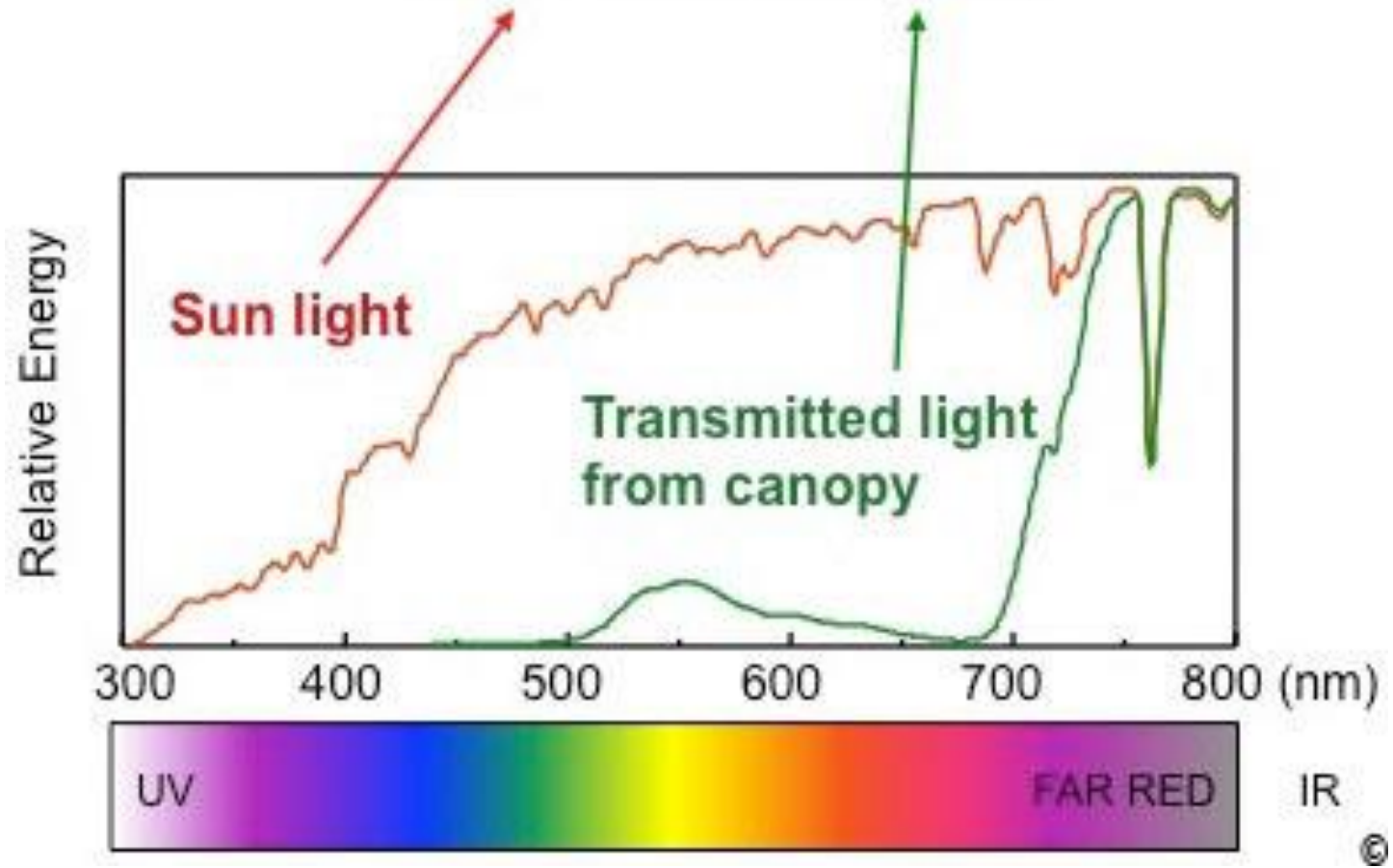
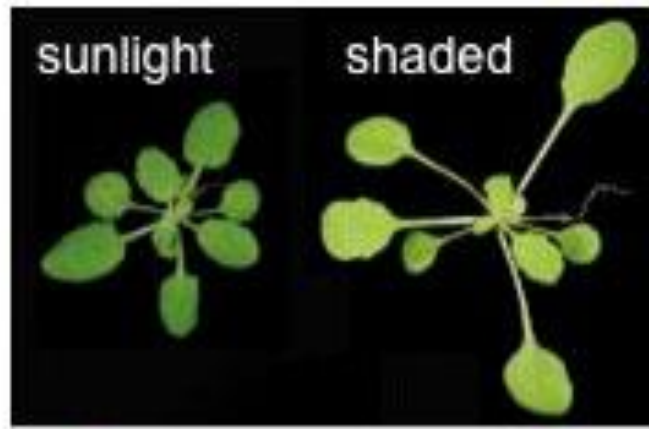
LES FEUILLES ABSORBENT DE LA LUMIERE

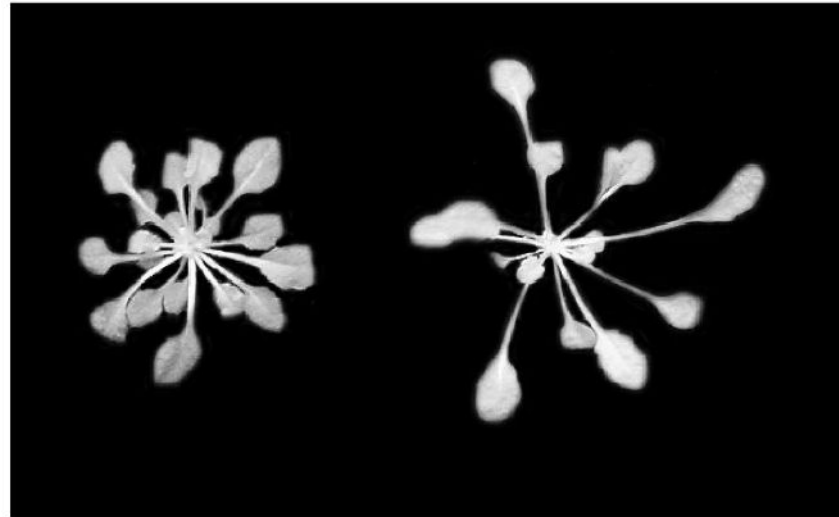


LES PLANTES PERCOIVENT L'OMBRE



EVITEMENT DE L'OMBRE





WT

phyB

The Plant Cell, Vol. 18, 2919–2928, November 2006, www.plantcell.org © 2006 American Society of Plant Biologists

**A Constitutive Shade-Avoidance Mutant Implicates
TIR-NBS-LRR Proteins in *Arabidopsis*
Photomorphogenic Development**

Ana Faigón-Soverna,^a Franklin G. Harmon,^{b,1} Leonardo Storani,^{a,c} Elizabeth Karayekov,^a Roberto J. Staneloni,^c
Walter Gassmann,^d Paloma Más,^e Jorge J. Casal,^a Steve A. Kay,^b and Marcelo J. Yanovsky^{a,2}

LES PLANTES PERCOIVENT LA PRESENCE D'UN COUVERT VEGETAL







**LES PLANTES PERCOIVENT LA PRESENCE D'AUTRE
PLANTES**

TIMIDITE DES CIMES

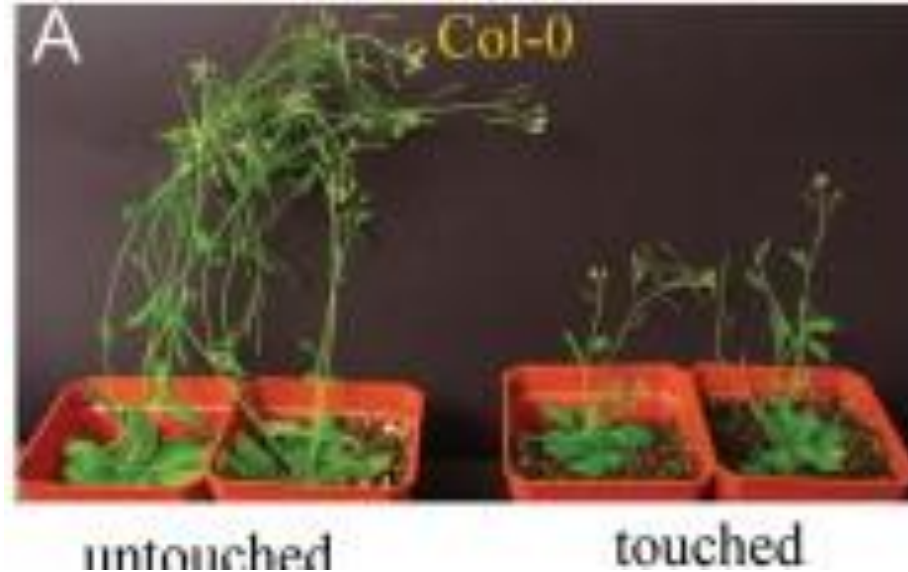
LES PLANTES PERCOIVENT LA PRESENCE D'AUTRE PLANTES

Current Biology 22, 701–706, April 24, 2012 ©2012 Elsevier Ltd All rights reserved DOI 10.1016/j.cub.2012.02.061

***Arabidopsis* Touch-Induced Morphogenesis Is Jasmonate Mediated and Protects against Pests**

E. Wassim Chehab,¹ Chen Yao,¹ Zachary Henderson,¹
Se Kim,¹ and Janet Braam^{1,*}

¹Department of Biochemistry & Cell Biology, Rice University,
Houston, TX 77005-1892, USA



ELLE ONT LE SENS DU TOUCHER

LES PLANTES PERCOIVENT LA PRESENCE D'UN SUPPORT



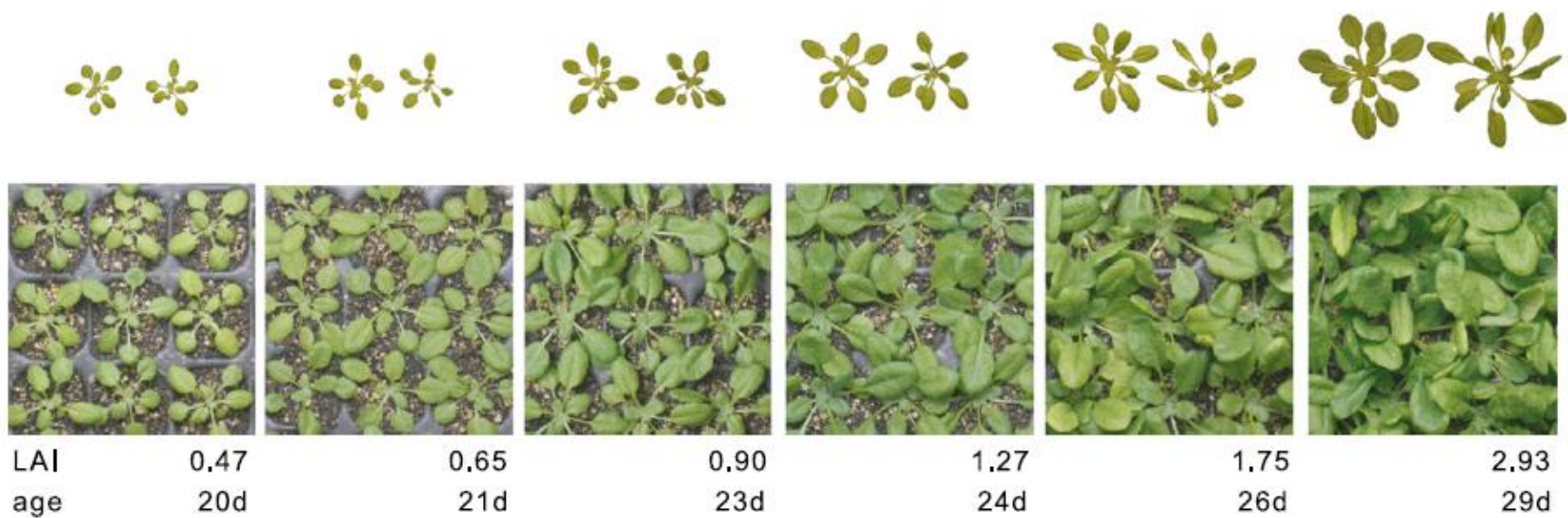
LA THIGMONASTIE

Plant neighbor detection through touching leaf tips precedes phytochrome signals

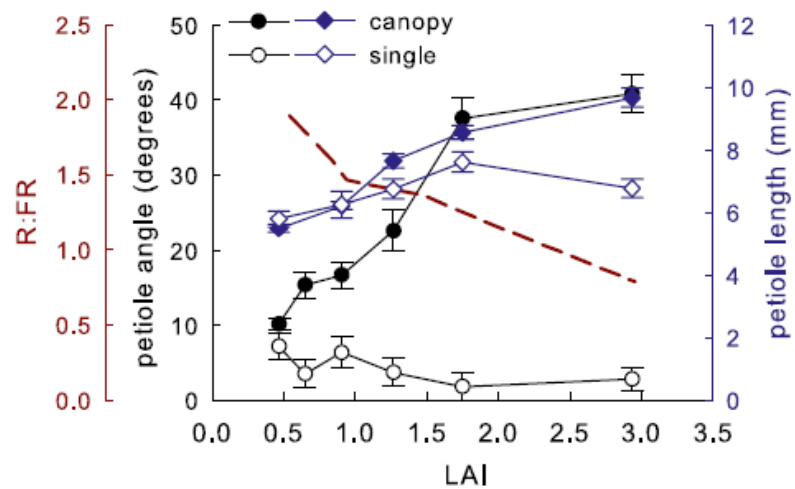
Mieke de Wit^{a,1,2}, Wouter Kegge^{a,2}, Jochem B. Evers^b, Marleen H. Vergeer-van Eijk^a, Paulien Gankema^a, Laurentius A. C. J. Voeseek^a, and Ronald Pierik^{a,3}

^aPlant Ecophysiology, Institute of Environmental Biology, Utrecht University, 3584 CH, Utrecht, The Netherlands; and ^bCentre for Crop Systems Analysis, Wageningen University, 6708 PB Wageningen, The Netherlands

A



B



LES PLANTES PERCOIVENT LEUR VOISINAGE

Plant neighbor detection through touching leaf tips precedes phytochrome signals

Mieke de Wit^{a,1,2}, Wouter Kegge^{a,2}, Jochem B. Evers^b, Marleen H. Vergeer-van Eijk^a, Paulien Gankema^a, Laurentius A. C. J. Voesenek^a, and Ronald Pierik^{a,3}

^aPlant Ecophysiology, Institute of Environmental Biology, Utrecht University, 3584 CH, Utrecht, The Netherlands; and ^bCentre for Crop Systems Analysis, Wageningen University, 6708 PB Wageningen, The Netherlands

A



B



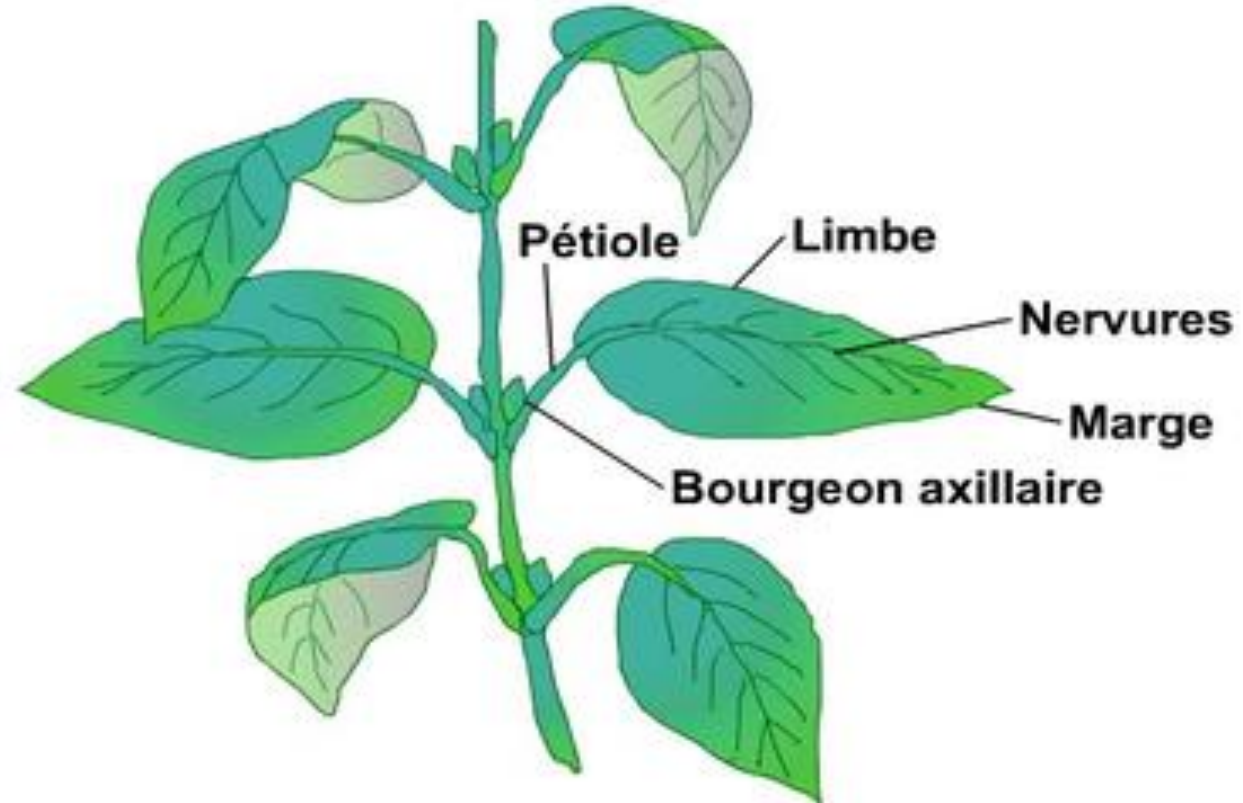
C



PAR LE TOUCHER > EVITEMENT DE L'OMBRE



Constitution d'une feuille





pétiolée



sessile



embrassante



amplexicaule



engainante



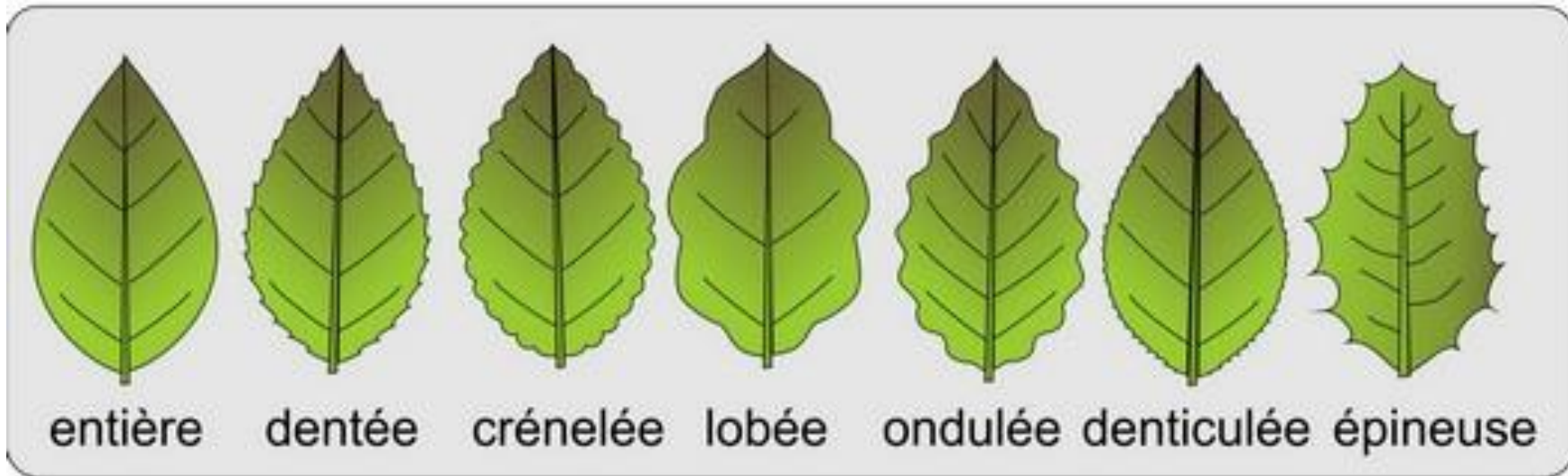
perfoliée



décurrente



connée

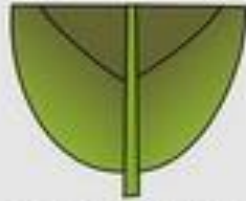




aigüe



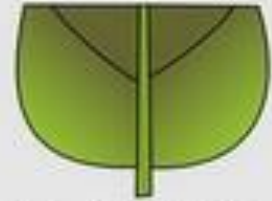
obtuse



arrondie



atténuée



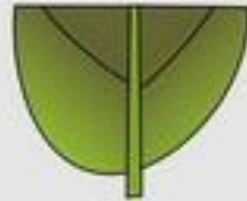
tronquée



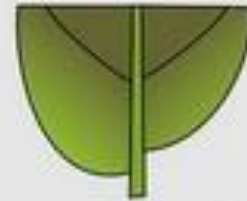
auriculée



cunéiforme



oblique



asymétrique



aigu



obtus



arrondi



atténué



tronqué



rétusé



échancré



fendu



caudé



cirrheux



vrillé



pennée
opposée



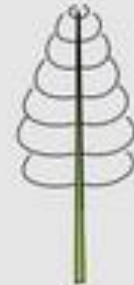
alterne



palmée



pédalée



anastomosée



uninervée



transverse



réticulée



dichotome



parallèle



en éventail

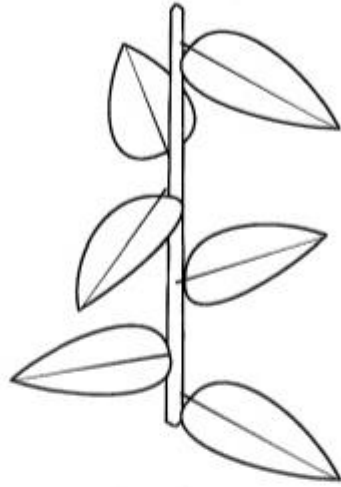


curvinervée



peltée

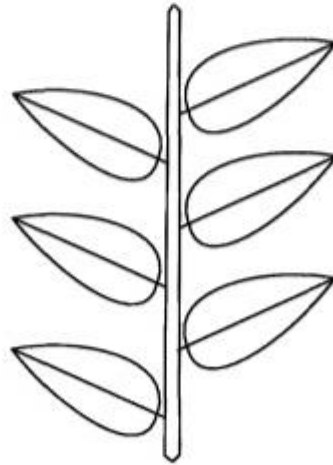
Phyllotaxie



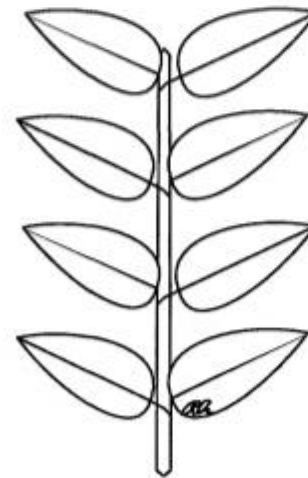
Spiralée



Feuilles opposées-décussées

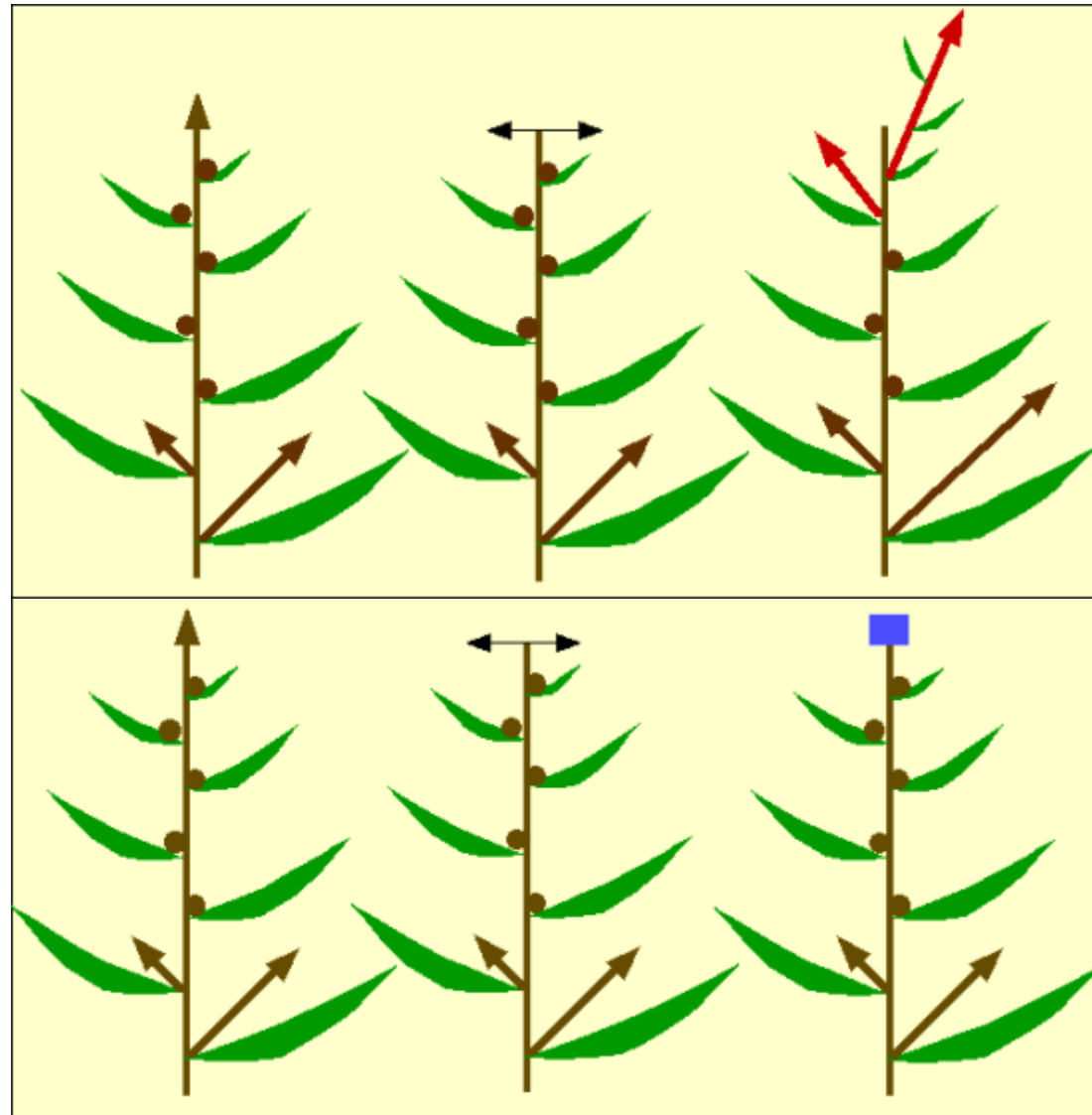


Distique

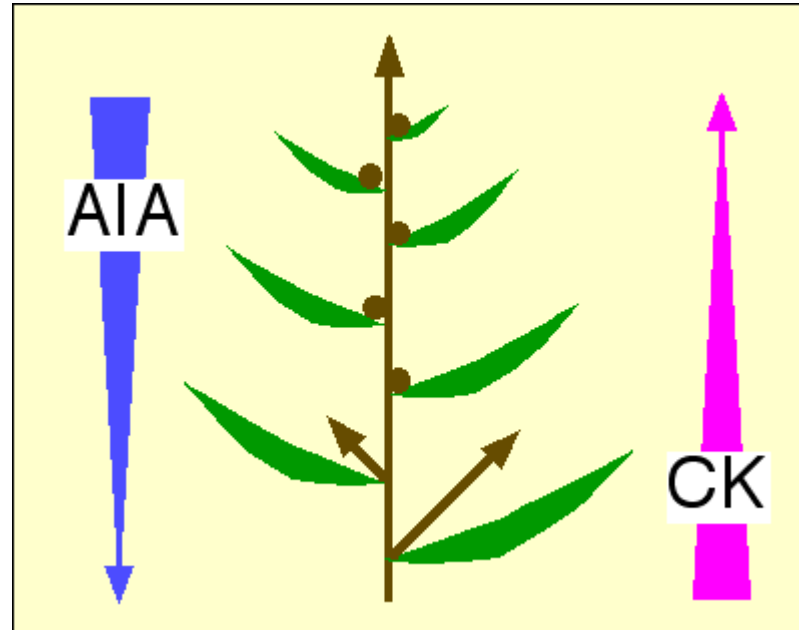
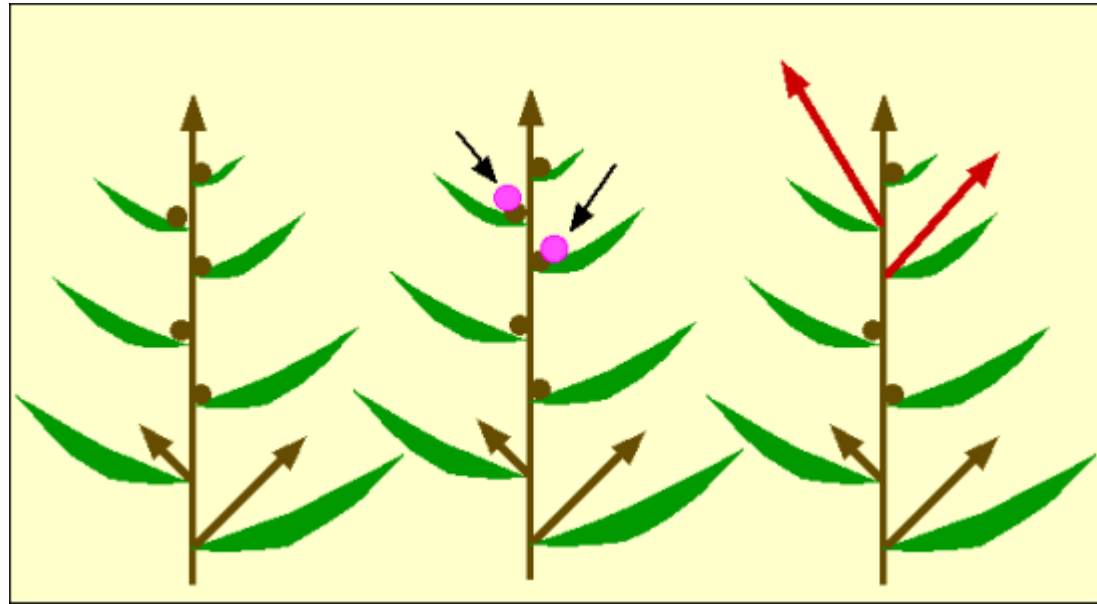


*Feuilles opposées-décussées
avec disposition secondaire*

LA DOMINANCE APICALE



L'AUXINE CONTRÔLE LA RAMIFICATION DES BRANCHES



CROISSANCE RYTHMIQUE

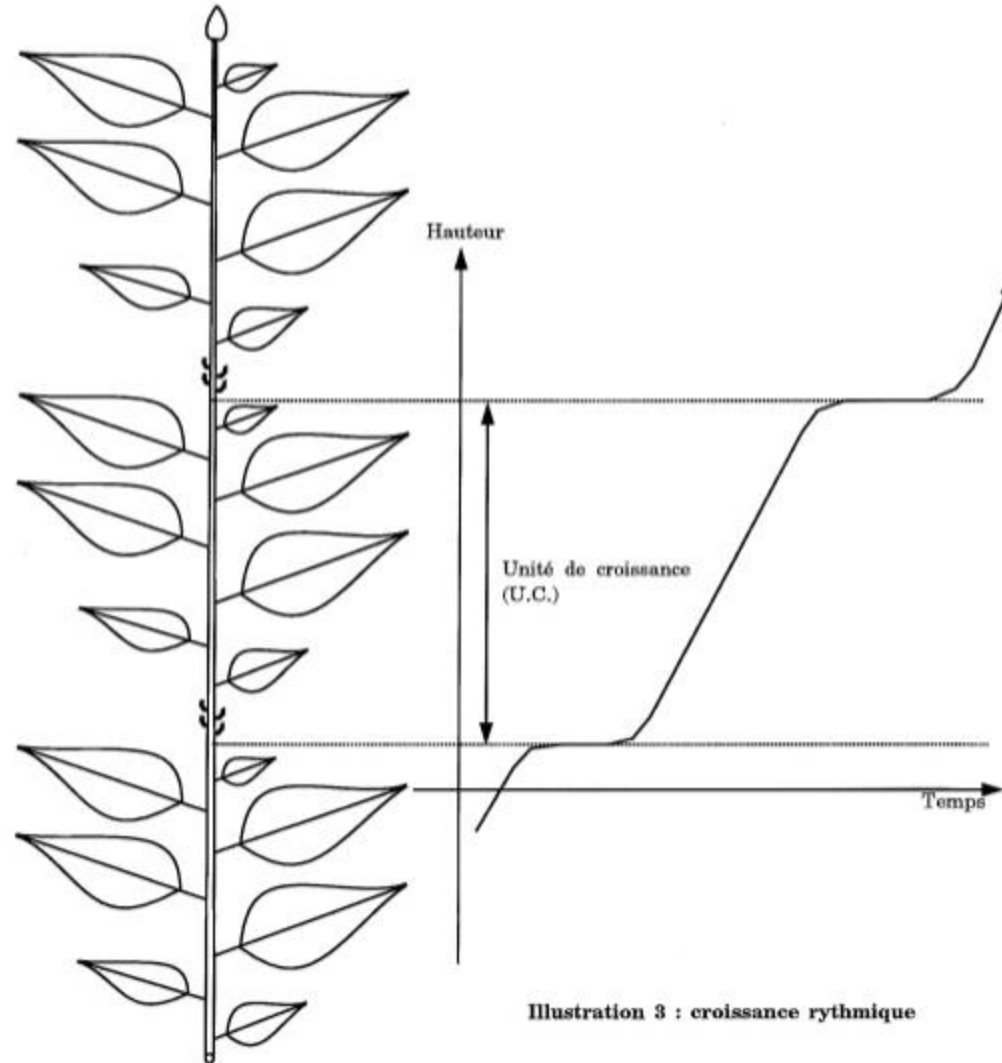
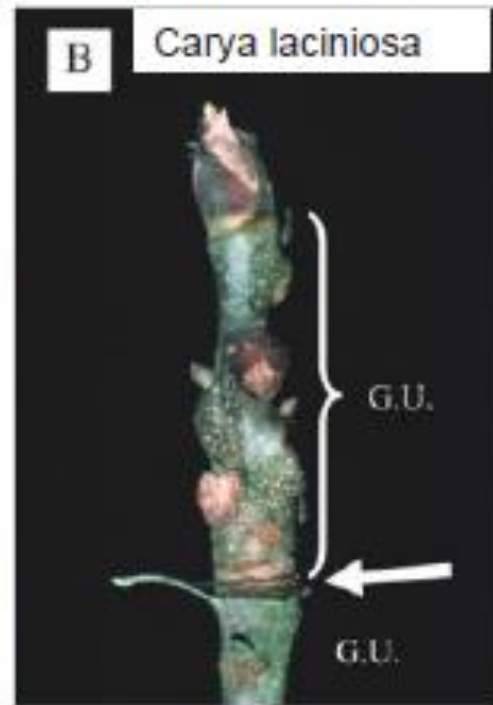


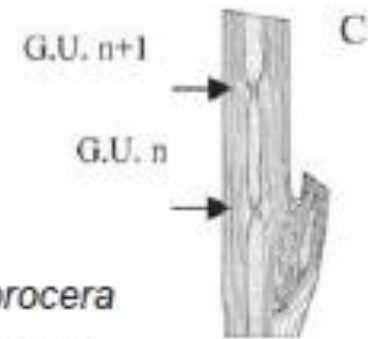
Illustration 3 : croissance rythmique



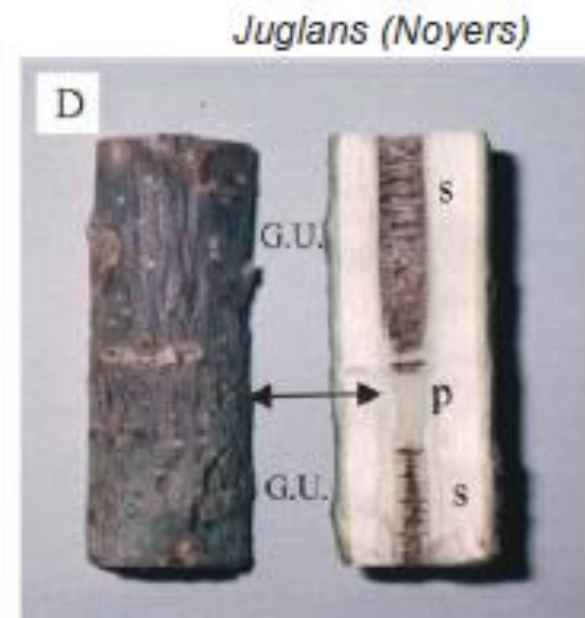
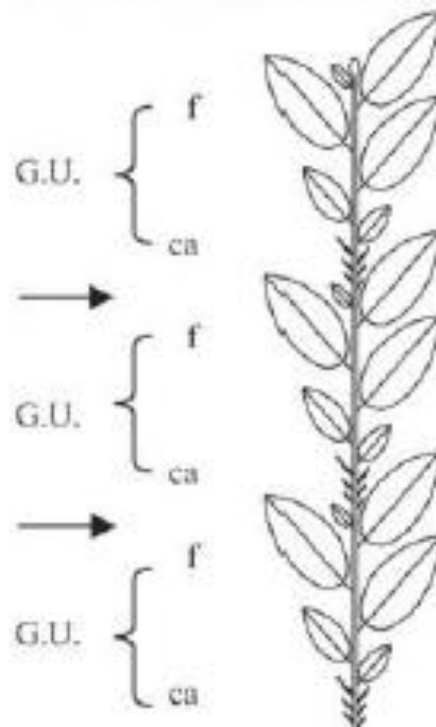
Détection des unités de croissance (GU)

- présence de cicatrice foliaire
- réduction de la taille des feuilles
- réduction du diamètre de la tige
- modification anatomique de la

moelle



Barthélémy et Caraglio, 2007





LA RAMIFICATION

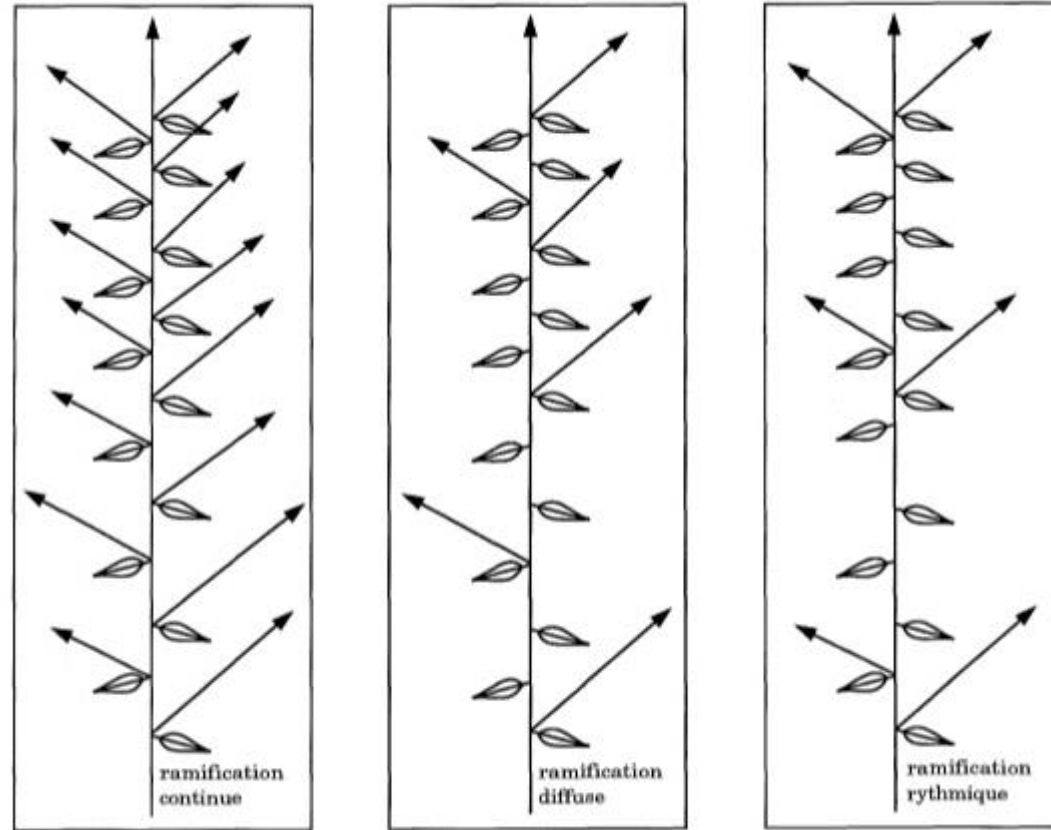
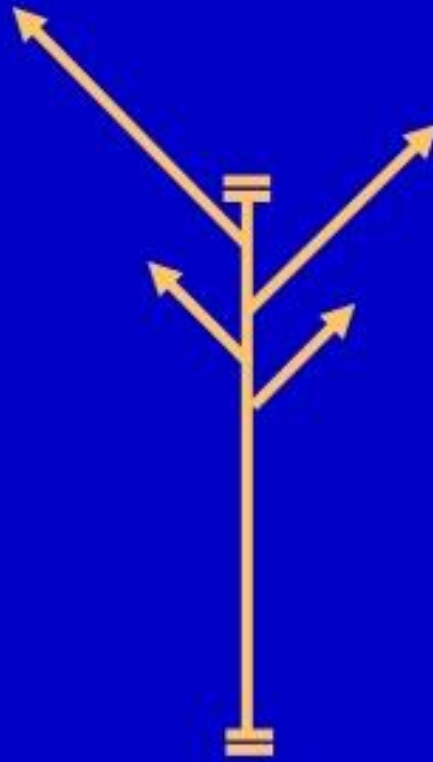


Illustration 7: types de ramification

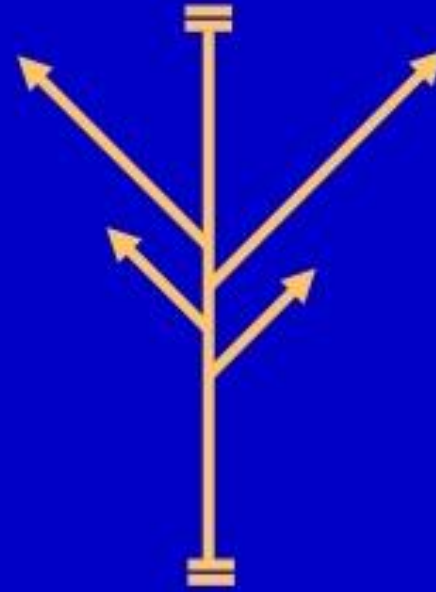
Sous nos climats : rythmique

Ramification acrotone, mésotone ou basitone



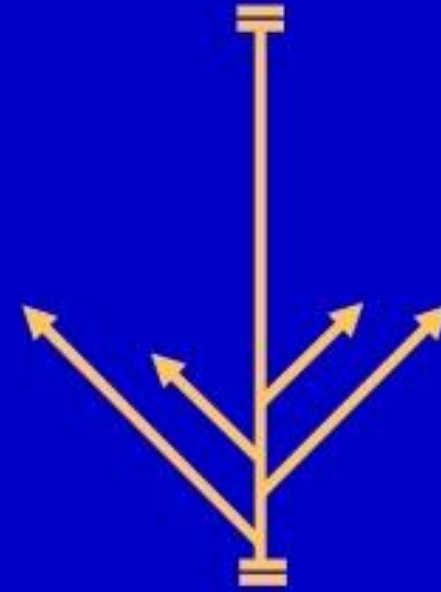
Les rameaux sont
situés au sommet
de l'entité

Acrotonie



Les rameaux sont
situés au milieu de
l'entité

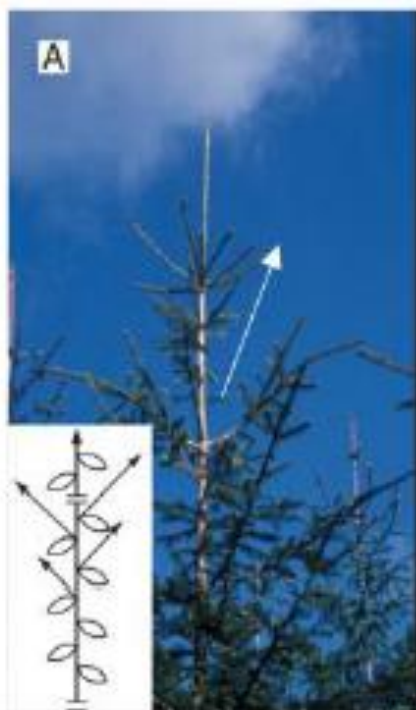
Mésotonie



Les rameaux sont
situés à la base de
l'entité

Basitonie

* ramification acrotone



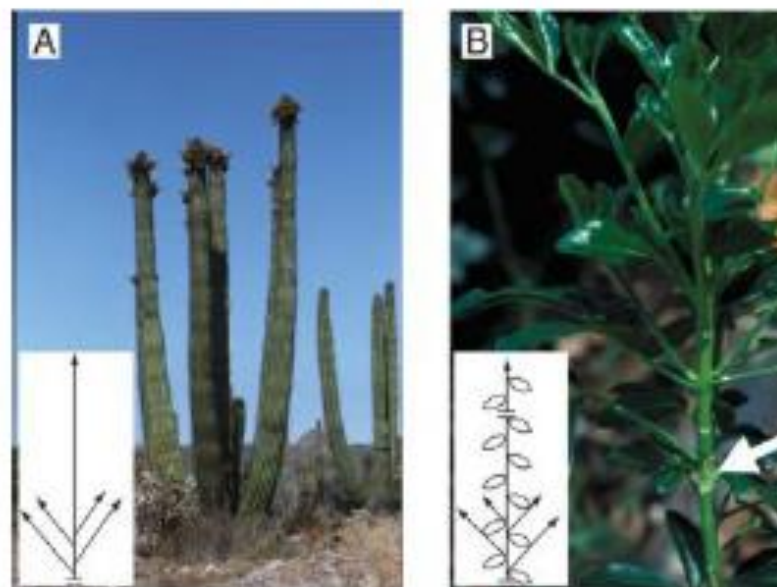
Abies alba (sapin)

* ramification mesotone



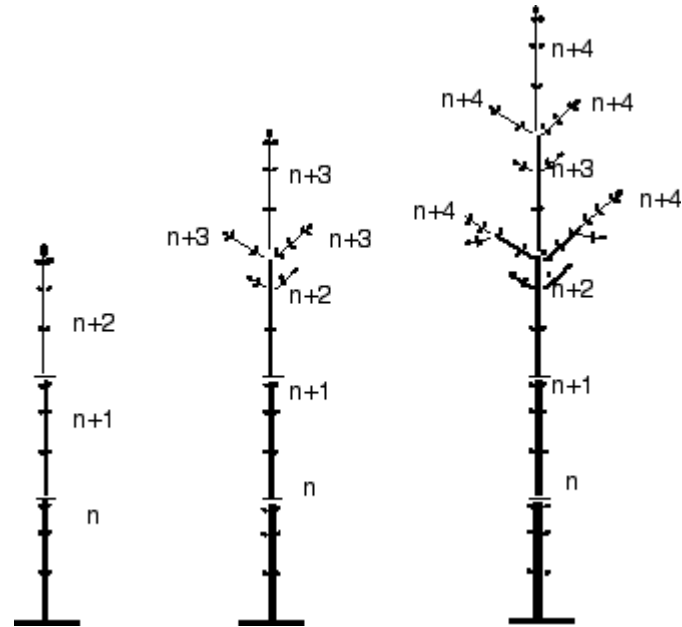
Cedrus atlantica (cèdre)

* ramification basitone



Barthélémy et Caraglio, 2007

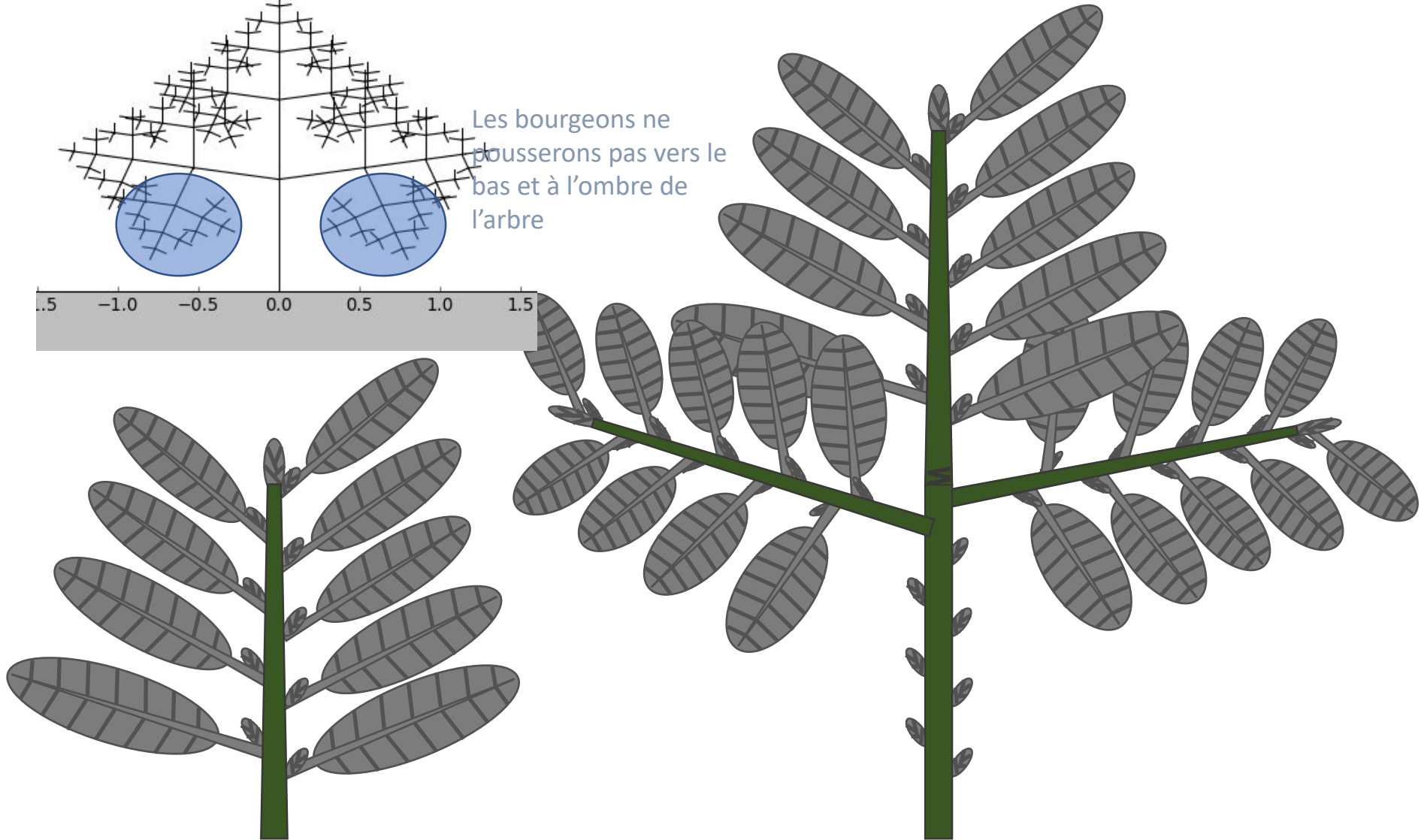
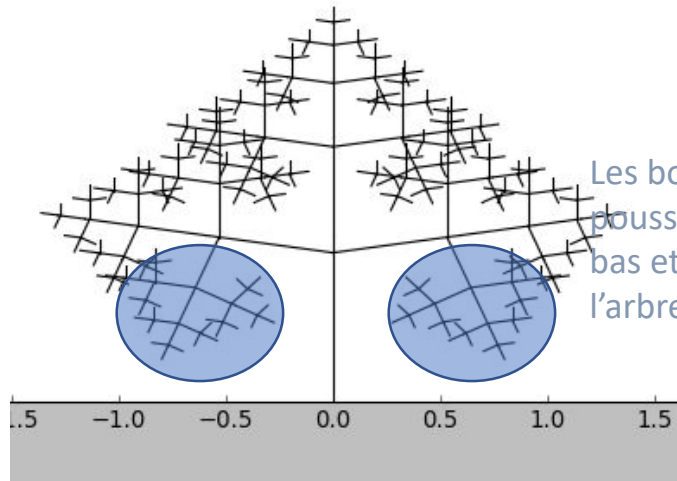
LA RAMIFICATION ET UNITE DE CROISSANCE



VERS L'ARCHITECTURE DE L'ARBRE



6 itérations





L'ORDRE DE RAMIFICATION

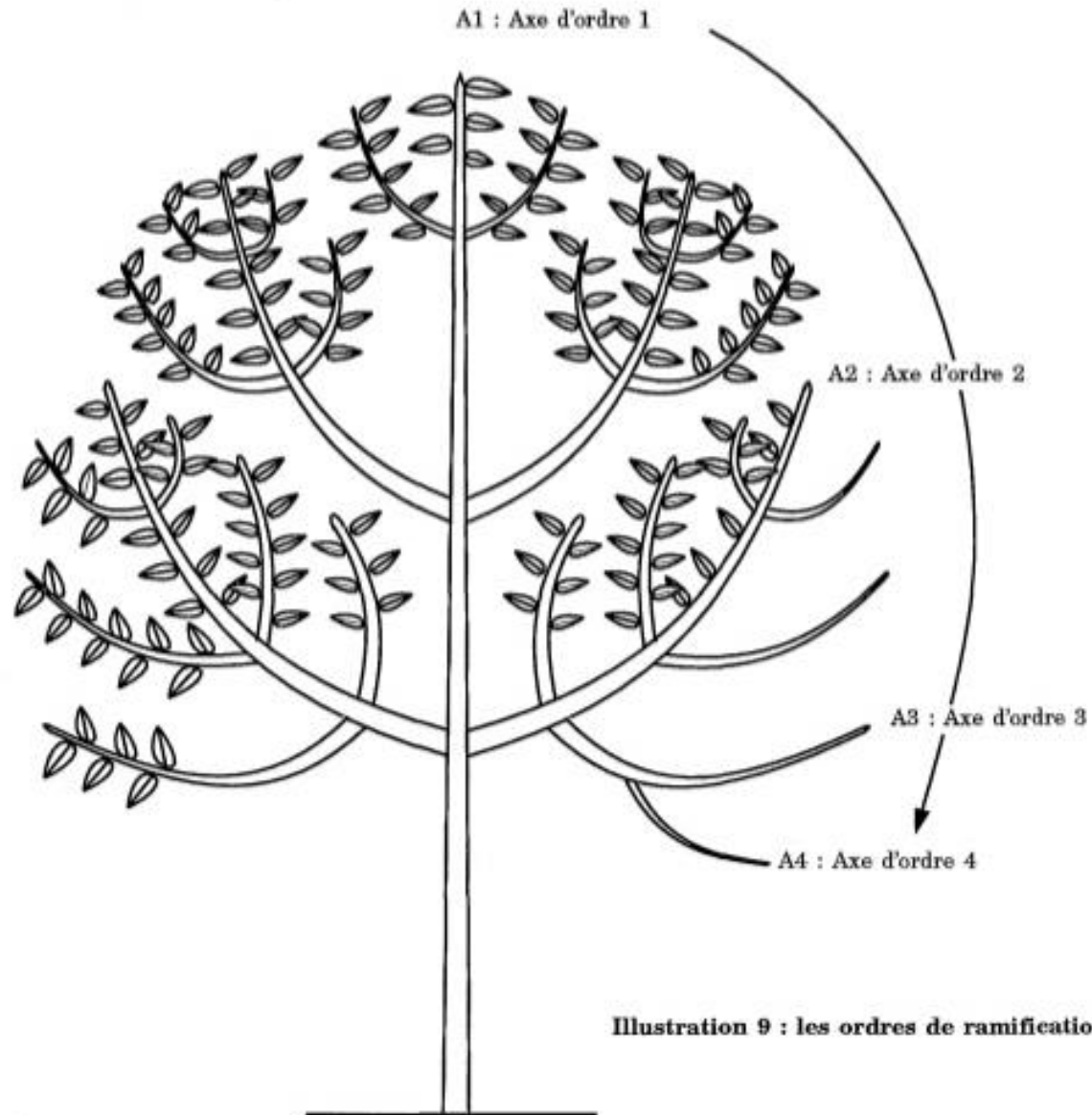


Illustration 9 : les ordres de ramification

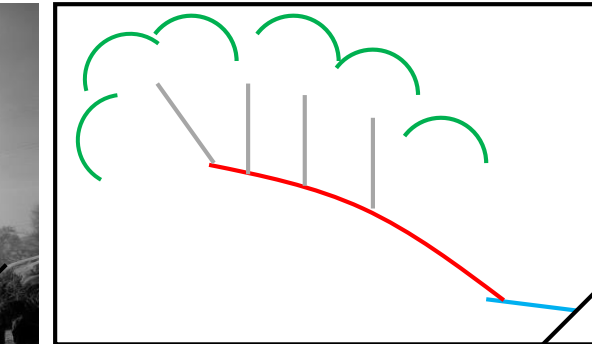
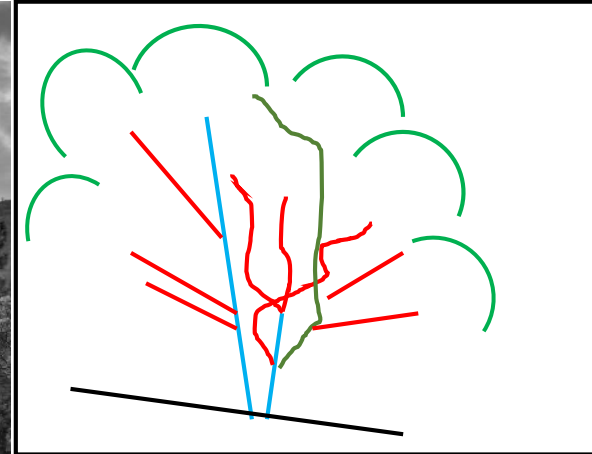
LIRE L'HISTOIRE D'UN ARBRE



LIRE L'HISTOIRE D'UN ARBRE



LIRE L'HISTOIRE D'UN ARBRE





Construire l'architecture de son arbre

Taille de formation /construction

Taille d'entretien

Taille de ramification /densification

Construire l'architecture de son arbre

Taille de formation

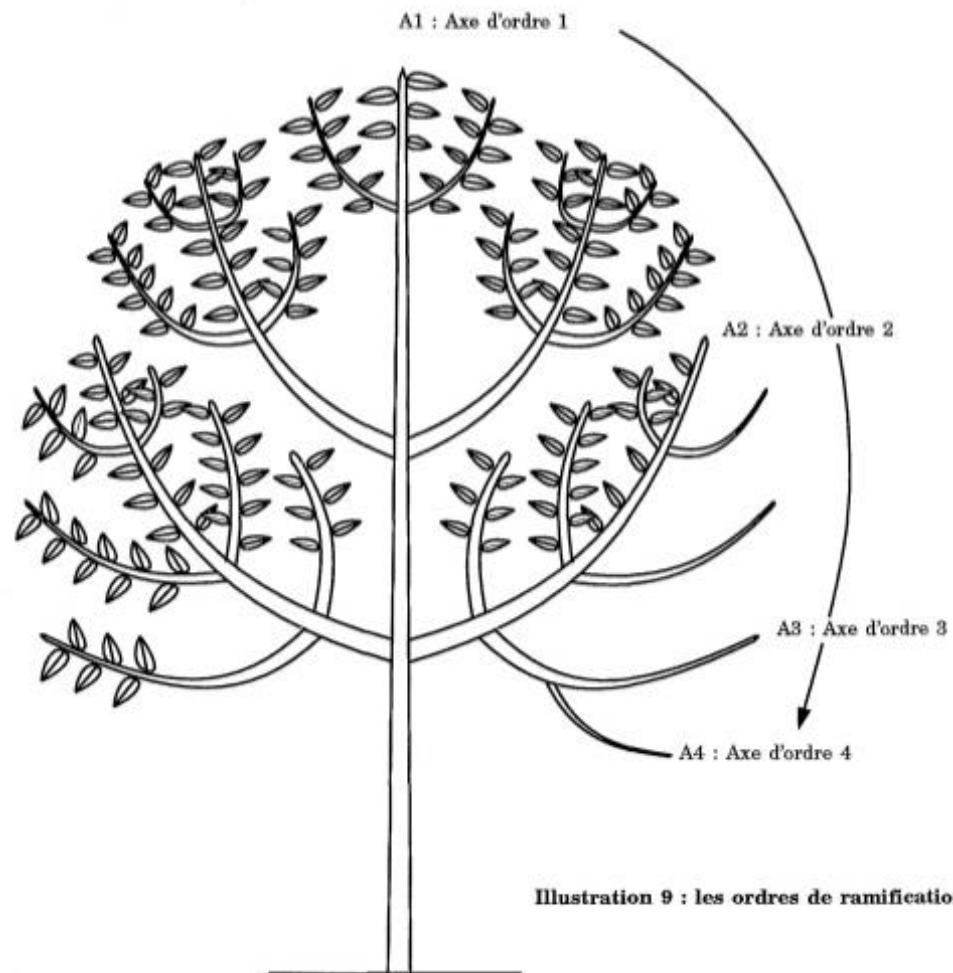
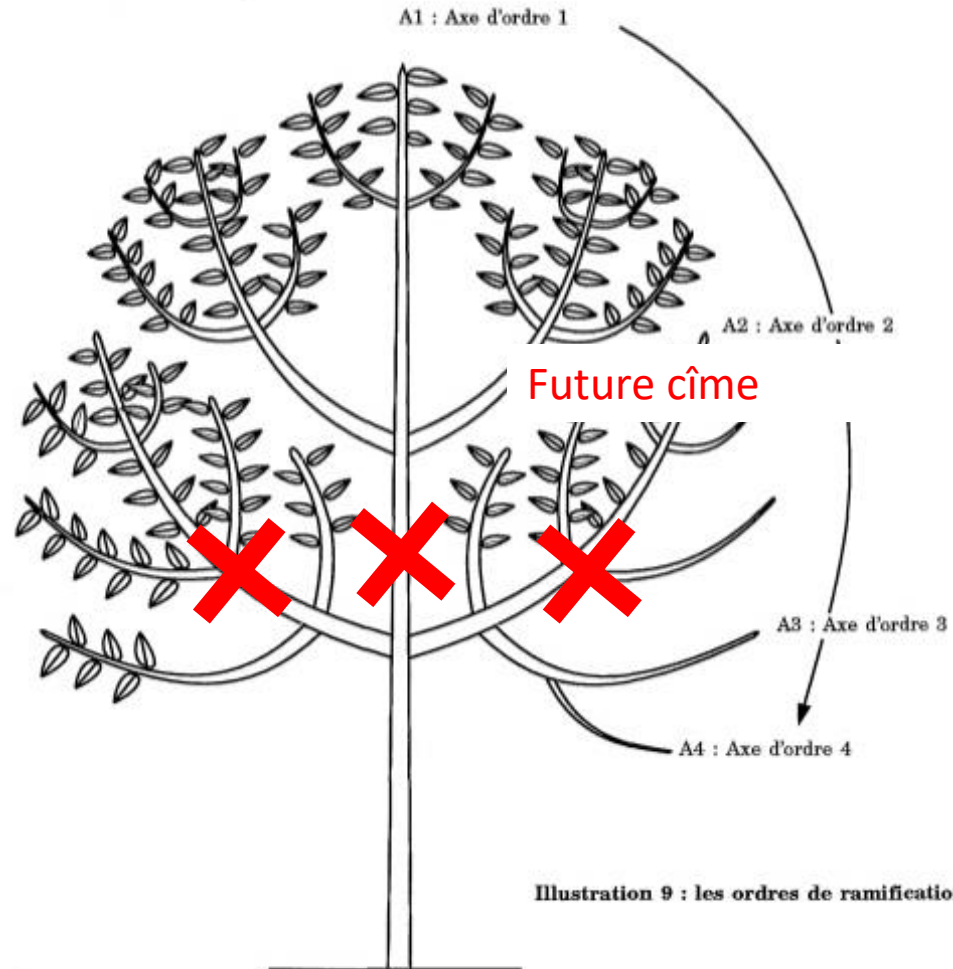


Illustration 9 : les ordres de ramification

Construire l'architecture de son arbre

Taille de formation



Reduire la taille

Construire l'architecture de son arbre

Taille de formation

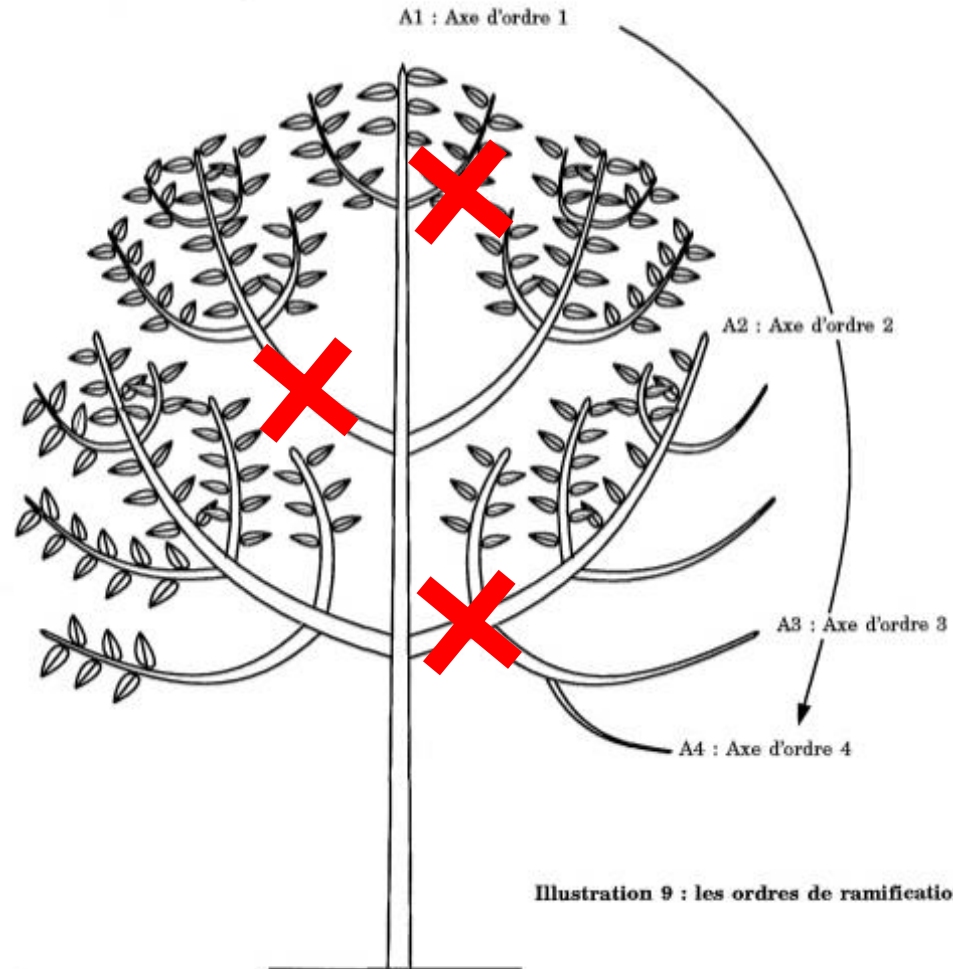
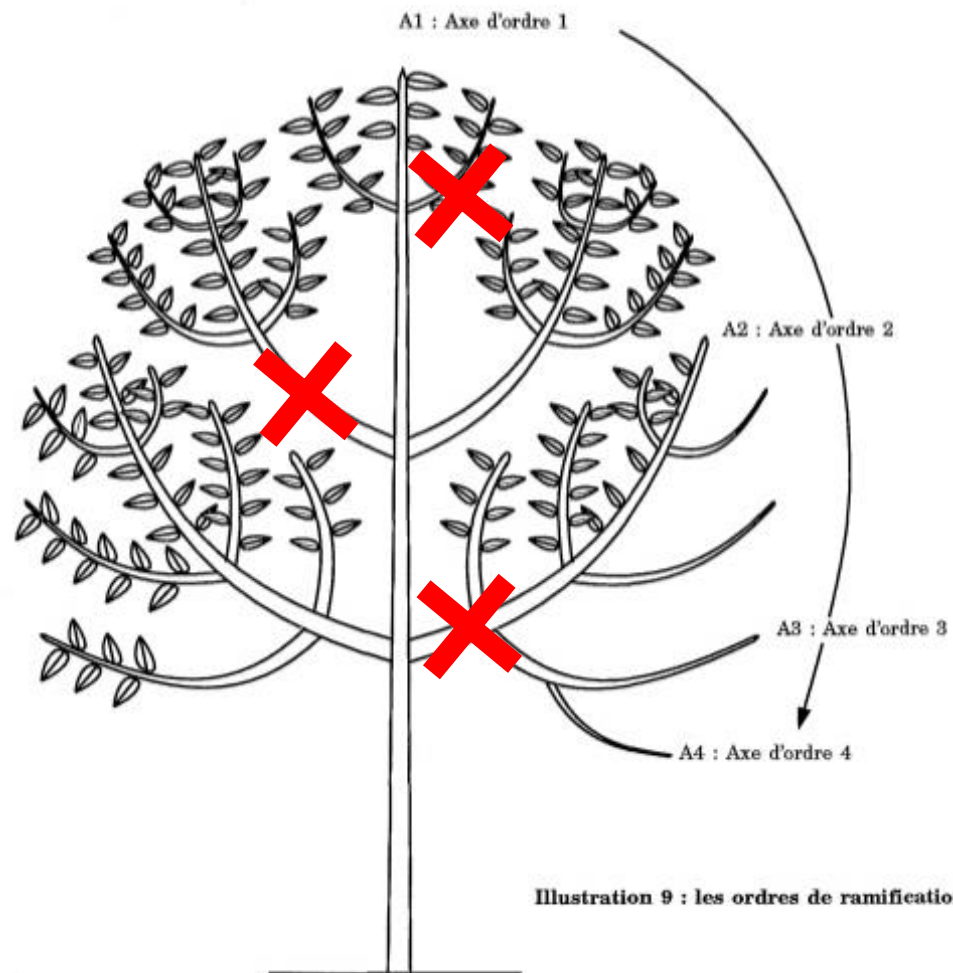


Illustration 9 : les ordres de ramification

Construire l'architecture de son arbre

Taille de formation



Construire l'architecture de son arbre

Taille d'entretien

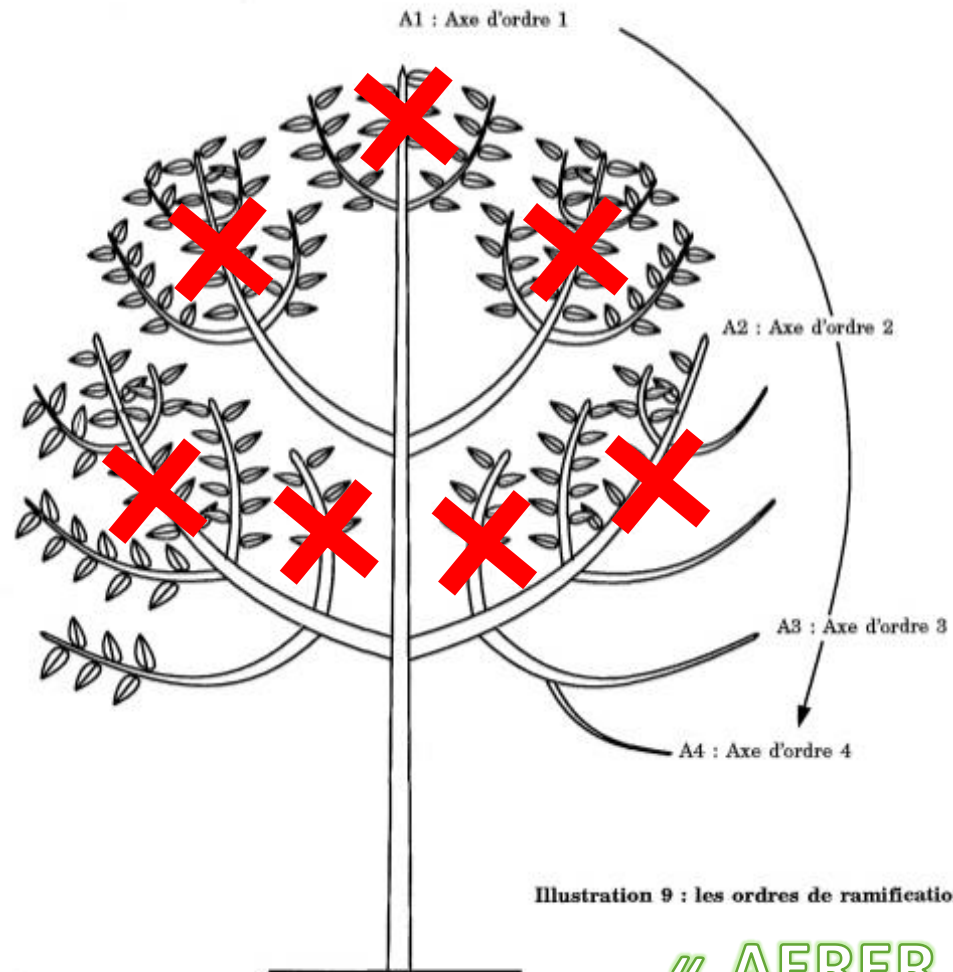


Illustration 9 : les ordres de ramification

« AERER » LA STRUCTURE

Construire l'architecture de son arbre

Taille de densification

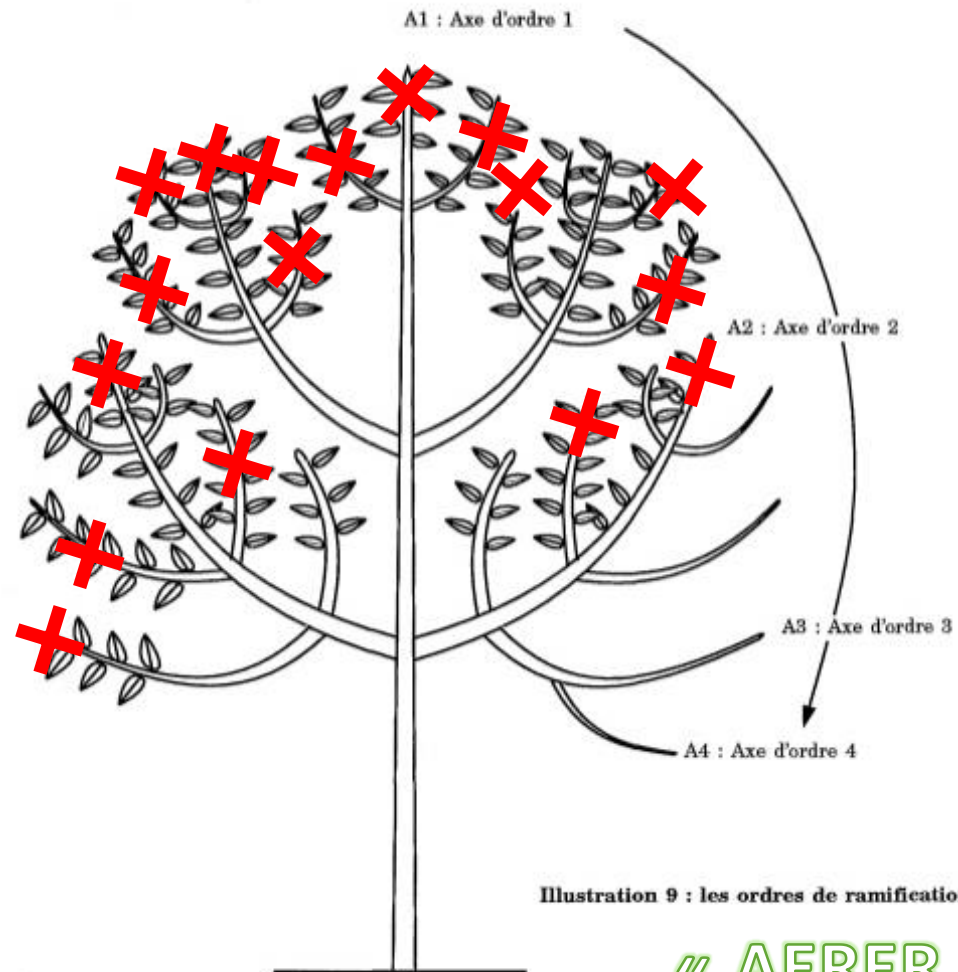


Illustration 9 : les ordres de ramification

« AERER » LA STRUCTURE

Construire l'architecture de son arbre

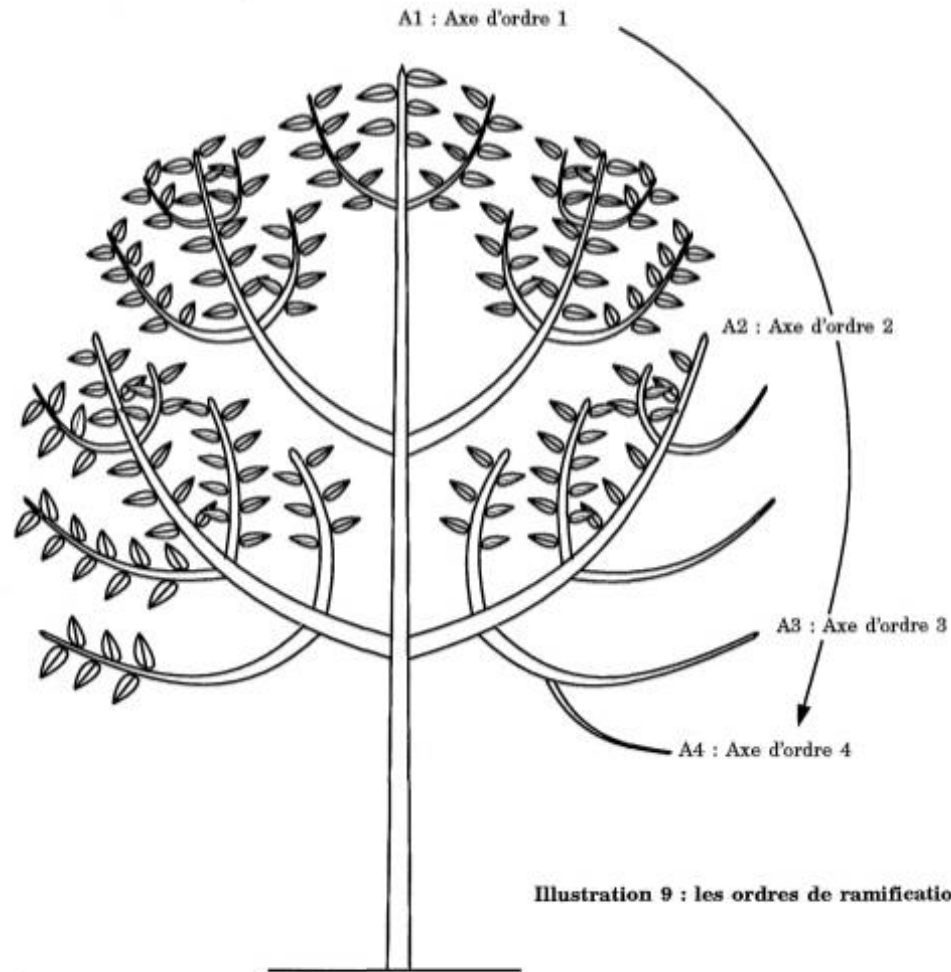


Illustration 9 : les ordres de ramification

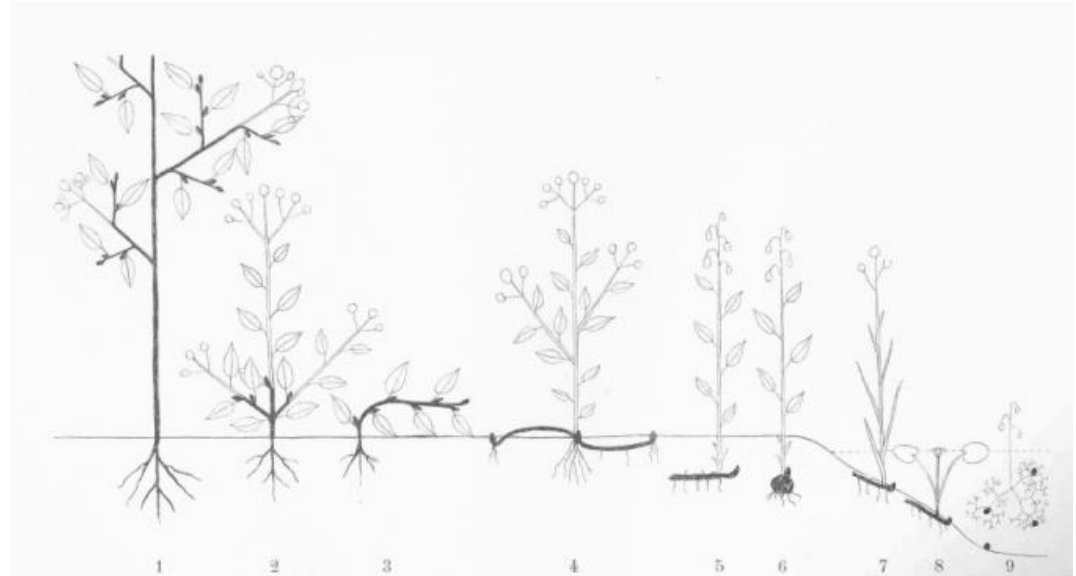
Avant de tailler :
avoir un projet de taille

Tailler toujours en fonction de
la physiologie de la plante

Vous devez pouvoir
prédire les effets de votre taille

I. Les arbres, une définition difficile

- Distingués depuis l'antiquité de manière empirique
- Raunkier (1905): Phanérophytes (du grec phaneros : apparent ; phuton : plante) :
bourgeons dormants aériens à plus de 50 cm de la surface du sol.



Dans les différentes définitions biologiques :

❓ Notion de taille: “grand” ?

❓ Notion de longévité: pérenne ?

❓ Notion de physiologie: un tronc, des branches, des feuilles ?,
Autoportant ?

Croissance verticale, végétal acrotone

❓ Notion d'anatomie : présence de méristèmes et tissus secondaires ?

En botanique : plantes à bois véritable = xylème secondaire produit par le cambium, à tronc bien individualisé

Buis (*Buxus sempervirens*)



Palmier dattier (*Phoenix dactilifera*)



Dans la suite du cours arbre = plante arborescente