ECOFISIOLOGIA VEGETAL

BT 791 Tópicos de Ecologia Vegetal

2º Semestre de 2017

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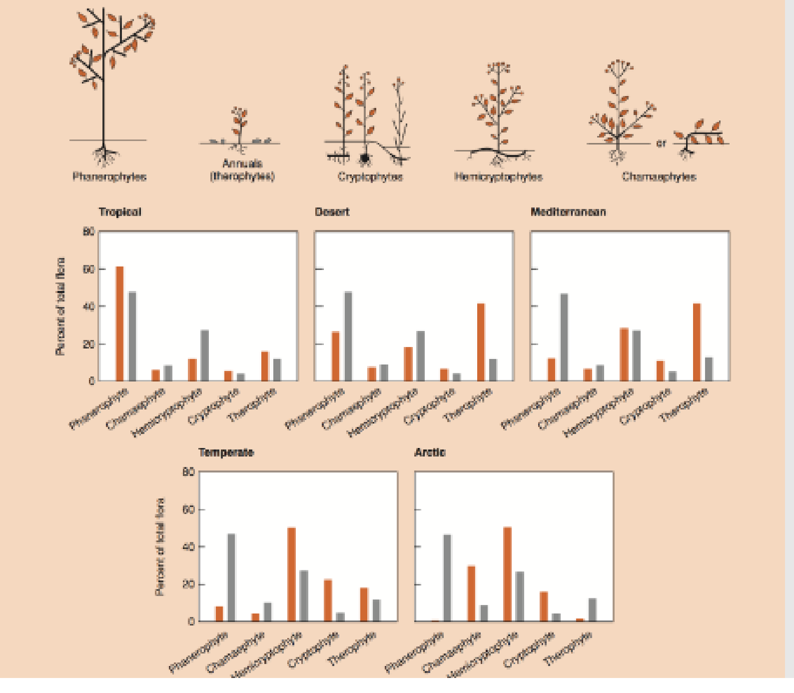
Formas de vida

Raunkiaer (1909) propôs um sistema baseado no grau de proteção das gemas.

Os organismos, dependendo de onde se encontrem, estão sujeitos a diferentes condições ambientais. Essas condições, variam quanto ao rigor. Sob ambientes rigorosos as gemas de regeneração devem estar protegidas. Em ambientes favoráveis, elas podem estar expostas.
Se isto é verdade, cada ambiente deve ser representado por um espectro biológico distinto, de acordo com as condições locais. Se as formas de vida não são influenciadas pelas condições ambientais de cada local, o espectro biológico em todas as áreas deve seguir o espectro normal.



	Phanerophytes (Trees)	Chamaephytes (Shrubs)	Hemicryptophytes (Perennial herbs)	Cryptophytes (Bulbs etc.)	Therophytes (Annuals)
World or 'Normal'	46	9	26	6	13
LATITUDE					
Tropical rain forest	96	2		2	
Sub tropical forest	65	17	2	5	10
Warm temperate forest	54	9	24	9	4
Cold temperate forest	10	17	54	12	7
Tundra	1	22	60	15	2
MOISTURE					
Mesophytic forest	34	8	33	23	2
Oak woodland	30	23	36	5	6
Dry grassland	1	12	63	10	14
Semi-desert		59	14	27	
Desert		4	17	6	73

The biological stress concept

A good physical analogue for developing the terminology is a spring. **Stress** is put on the spring by **strain**. **Reversible stress** is brought about by strain in the elastic range of the spring material: **elastic strain**. **Irreversible stress** is due to strain beyond the elastic range of the spring material: **plastic strain**.

The biological stress concept was developed by Selye (1973), Levitt (1980) and Larcher (1987). Any external factor (biotic or abiotic) and internal factor can induce stress, i.e. become a **stressor**, if its dosage is too high or too low. The terminology of the biological stress concept is explained in the diagram giving four different possible cases for the development of a biological system with time (abscissa).

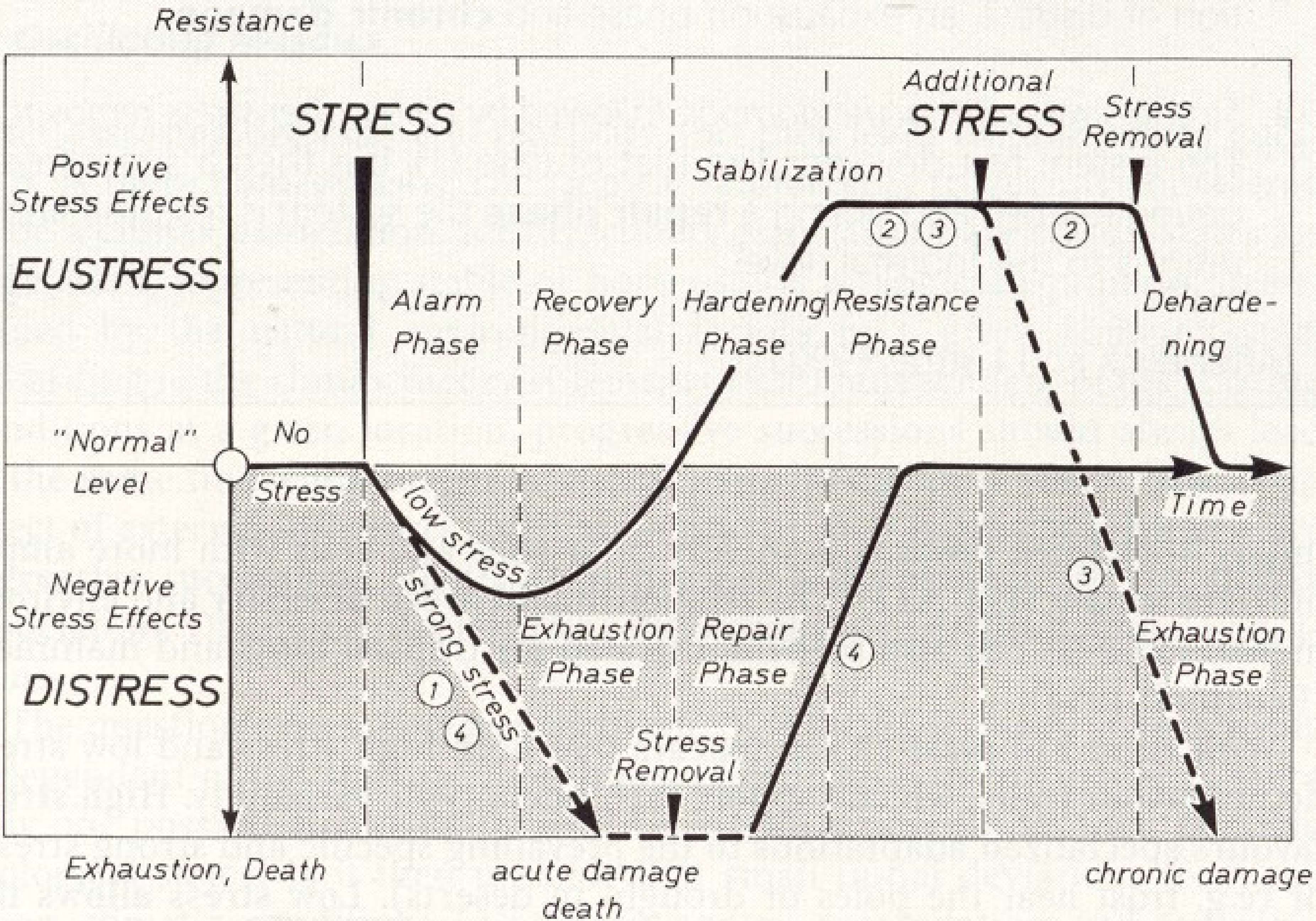
1. *Strong stress*
   Strong stress out of an **alarm phase** more or less rapidly leads into a phase of **exhaustion** followed by **acute damage** and death. The stress has negative effects, it is a **distress**.

2. *Low stress followed by stress removal*
   Low stress leads into an **alarm phase** generating recovery mechanisms. In a **recovery phase** the system develops out of the conditions in which stress has negative effects, to conditions in which stress has positive effects and stimulates the system; stress is a **eustress**. The system stabilizes during a **hardening phase** and attains a **resistance phase**, in which it may remain, unless the degree of stress is changed or **external or internal reserves** required for resistance are exhausted. With respect to the latter, it is clear that time, i.e. the duration of stress application may be important. Upon stress removal the system enters a **dehardening phase** and returns to the normal level.

3. *Low stress followed by additional stress*
   The system first develops like that of case (2), but then additional stress is applied either by the original stress becoming stronger or by additional different stressor(s). The system now goes into the condition of distress, an exhaustion phase and **chronic damage**.

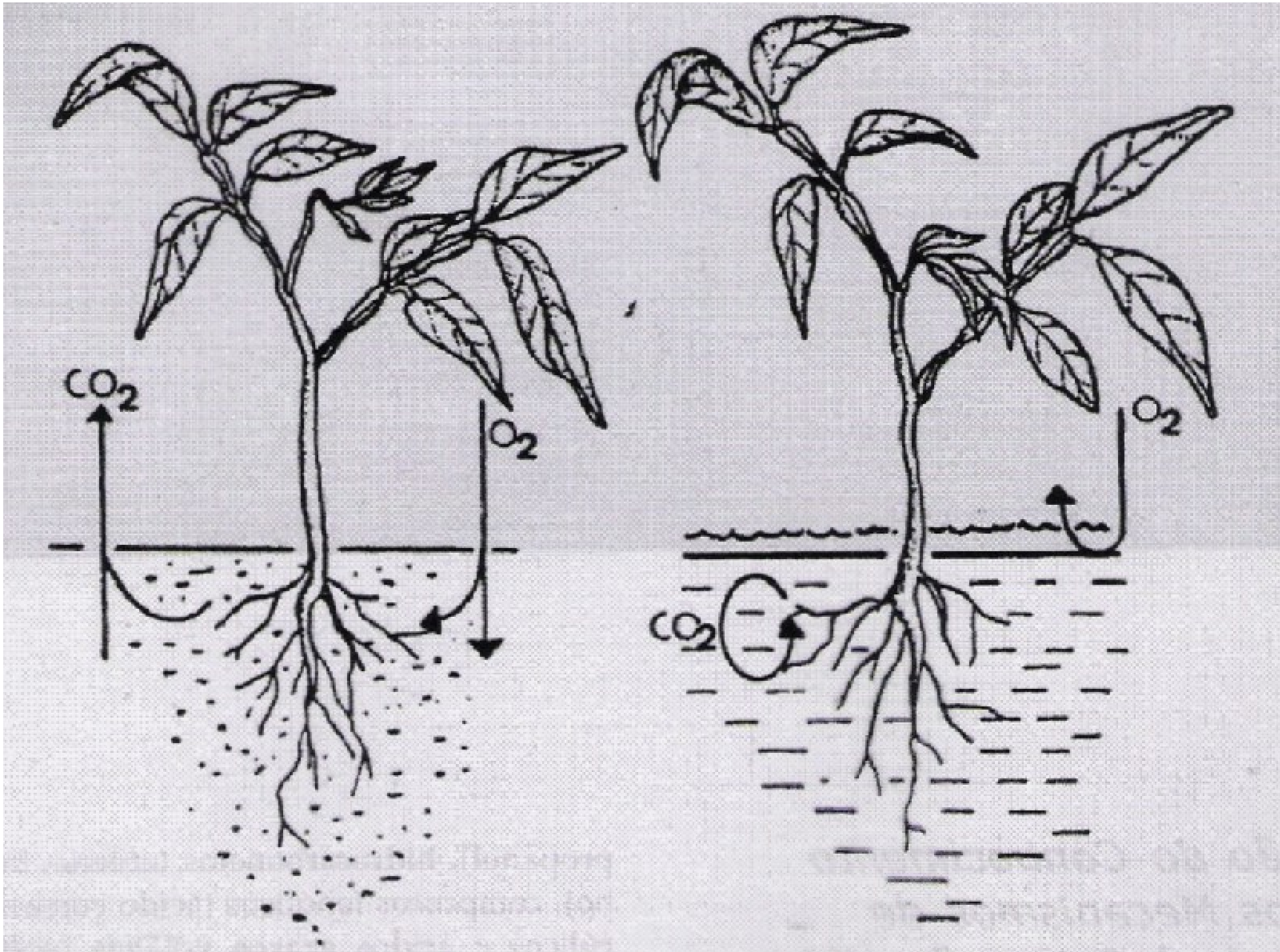
4. *Strong stress with acute damage followed by repair after stress removal*
   The system first develops like that of case (1), but then a stress-free period follows, and during a **repair phase** the system is restored and returns to the "normal" level.

(After Beck and Lüttge 1990.)


Resistance
Positive Stress Effects
EUSTRESS
"Normal" Level
Negative Stress Effects
DISTRESS
Exhaustion, Death
STRESS
No Stress
Alarm Phase
Recovery Phase
Hardening Phase
Stabilization
Resistance Phase
Additional STRESS
Stress Removal
Deharde-ning
low stress
strong stress
Exhaustion Phase
Repair Phase
Stress Removal
Time
Exhaustion Phase
acute damage death
chronic damage
1
2
3
4

Exemplos de Estresse

Saturação Hídrica do Solo


CO_2
O_2
O_2
CO_2

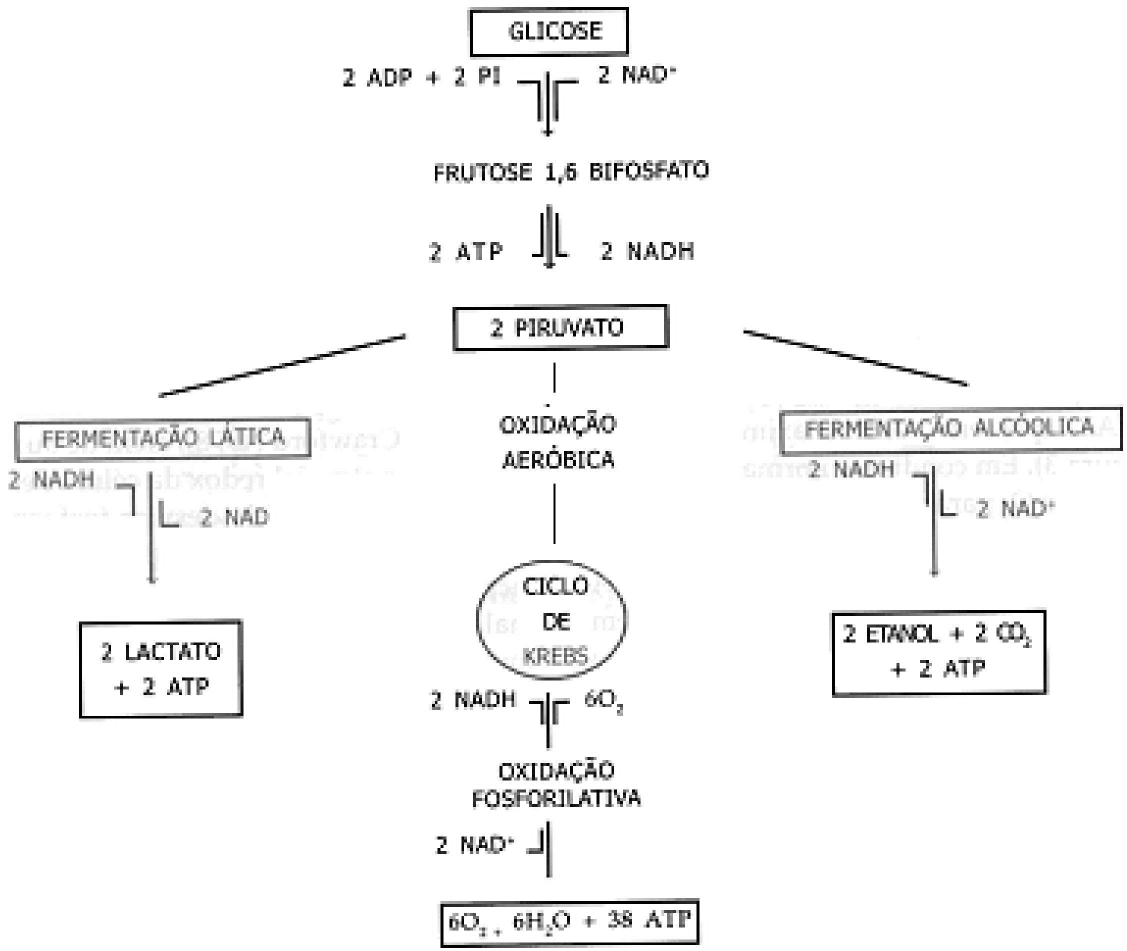


Figura 4. *Principais vias de oxidação da glicose e a produção de ATP. Modificado de Voet & Voet 1995.*

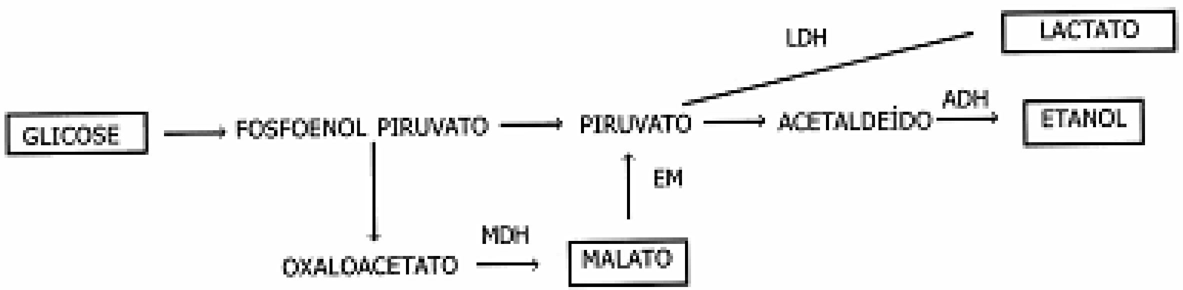
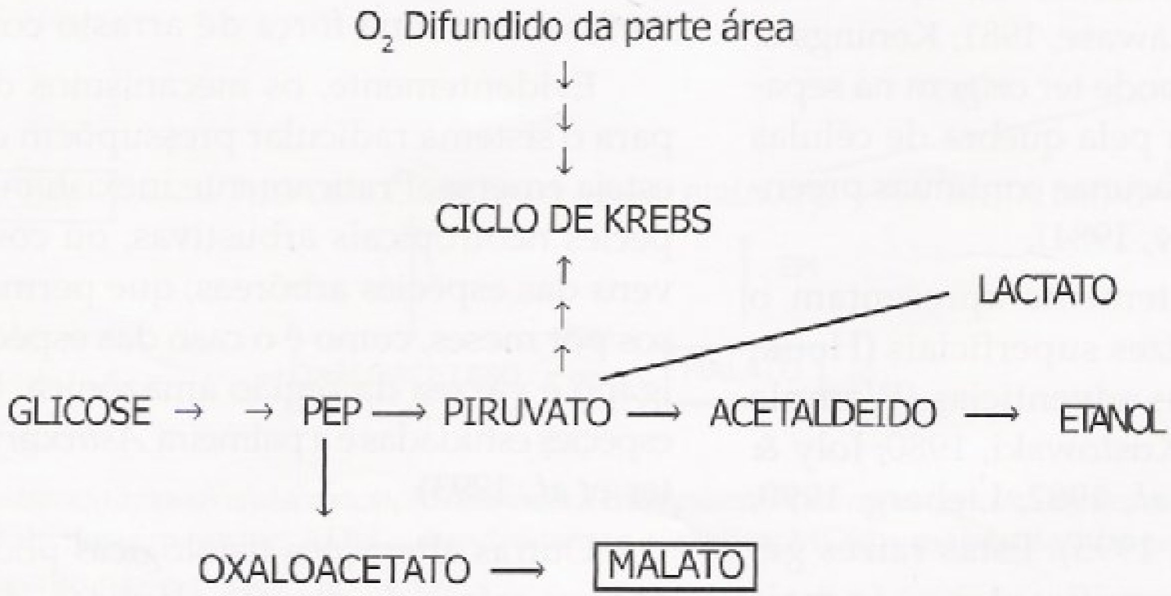
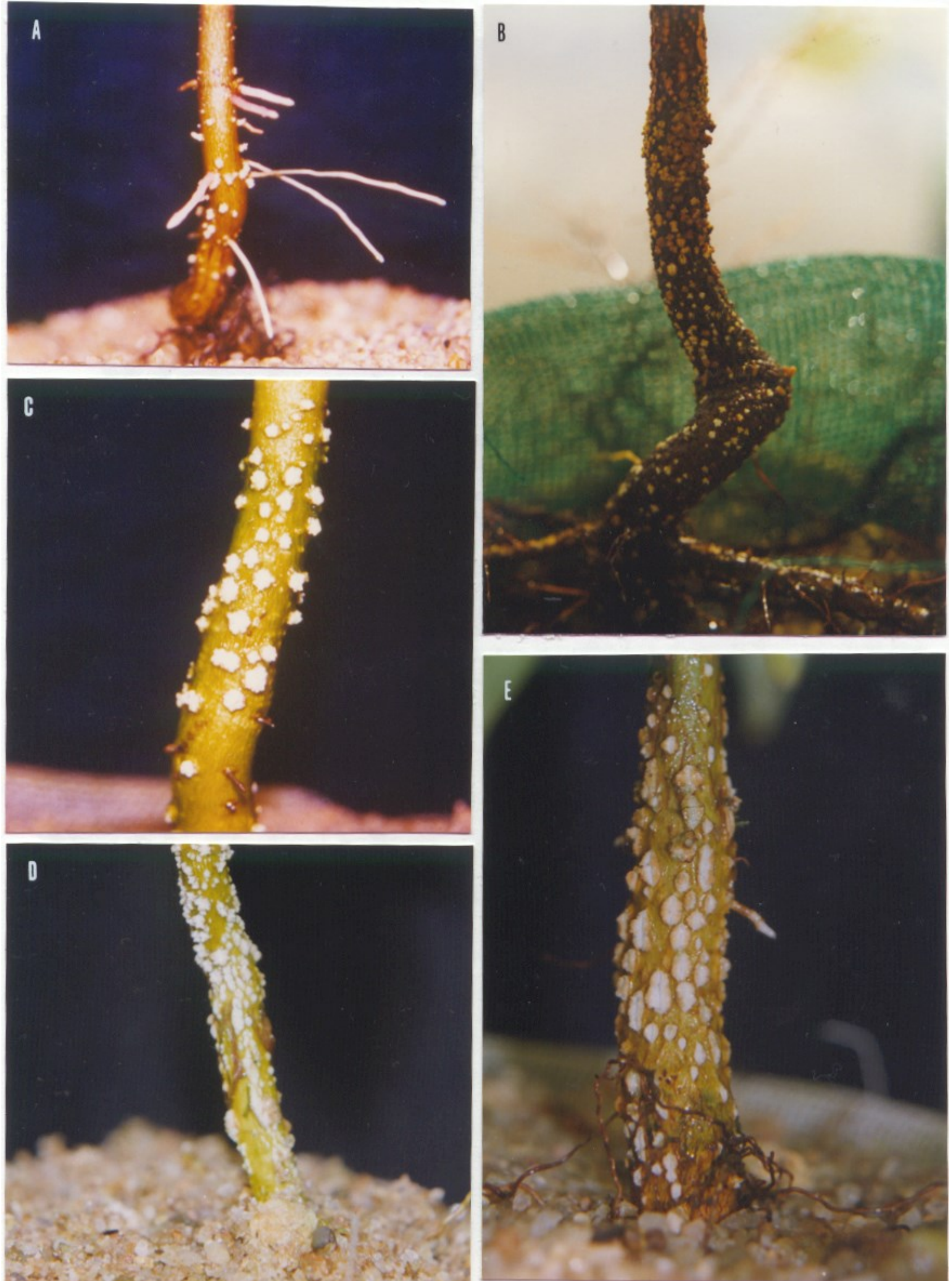
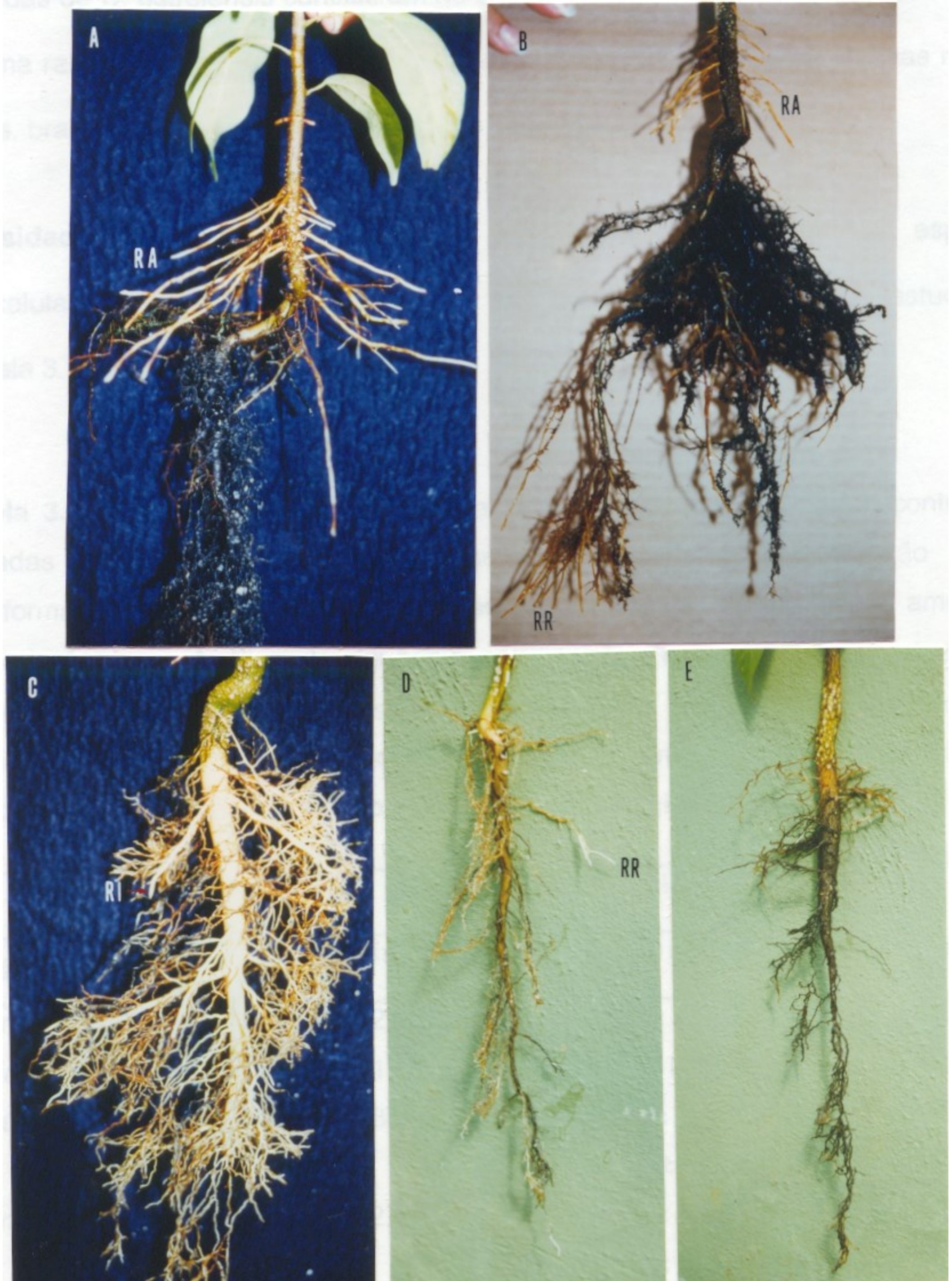


Figura 5. *Diagrama ilustrando a possível diferenciação metabólica entre plantas tolerantes e não tolerantes ao alagamento, segundo Crawford 1978.* LDH = Lactato desidrogenase; ADH = desidrogenase alcóolica; MDH = malato desidrogenase; EM = enzima málica, inibida pelo alagamento nas espécies tolerantes.

O papel do acúmulo de malato e a participação do oxigênio difundido pela parte aérea no metabolismo radicular de plantas alagadas. Proposto por Joly 1994b.




A
B
C
D
E


A
RA
B
RA
RR
C
RI
D
RR
E

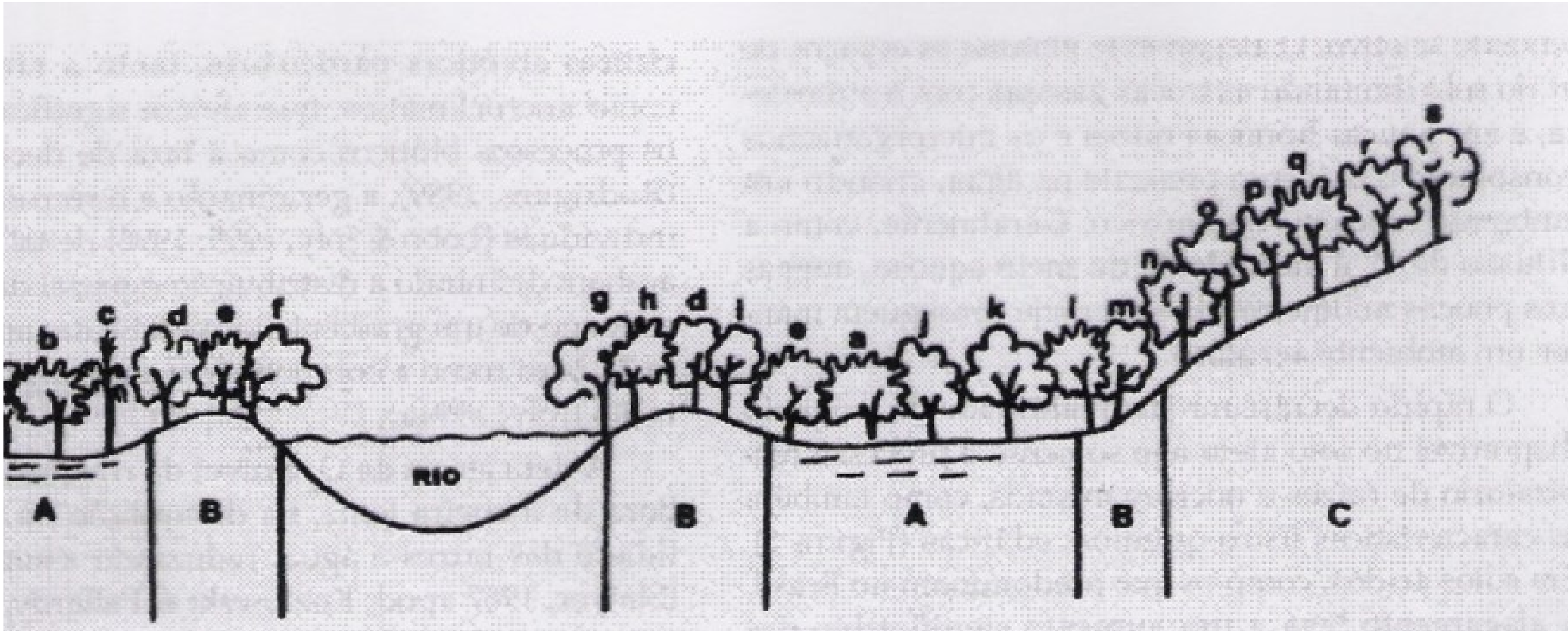

b c d e f
g h d i e a j k l m
n o p q r s
RIO
A
B
B
A
B
C

FIGURE 4 - Diagram of the gradient of hidric saturation of the soil in the Jacaré-Pepira river.

A - permanently waterlogged areas; B - seasonally flooded areas; C - well drained areas - transition to the mesophytic semideciduous forest.

a - Calophyllum brasiliense; b - Croton urucurana; c - Arecastrum romanzoffianum; d - Copaifera langsdorffii; e - Inga affinis; f - Ficus citrifolia; g - Sebastiania brasiliensis; h - Tapirira guianensis; i - Enterolobium contortisiliquum; j - Talauma ovata; k - Protium heptahyllum; l - Genipa americana; m - Pseudobombax grandiflorum; n - Centrolobium tomentosum; o - Cariniara estrelensis; p - Aspidosperma cylindrocarpon; q - Tabebuia chrysotricha; r - Cordia trichotoma; s - Astronium graveolens.

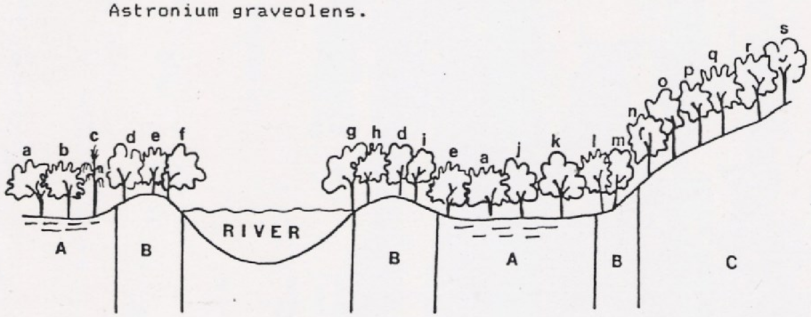
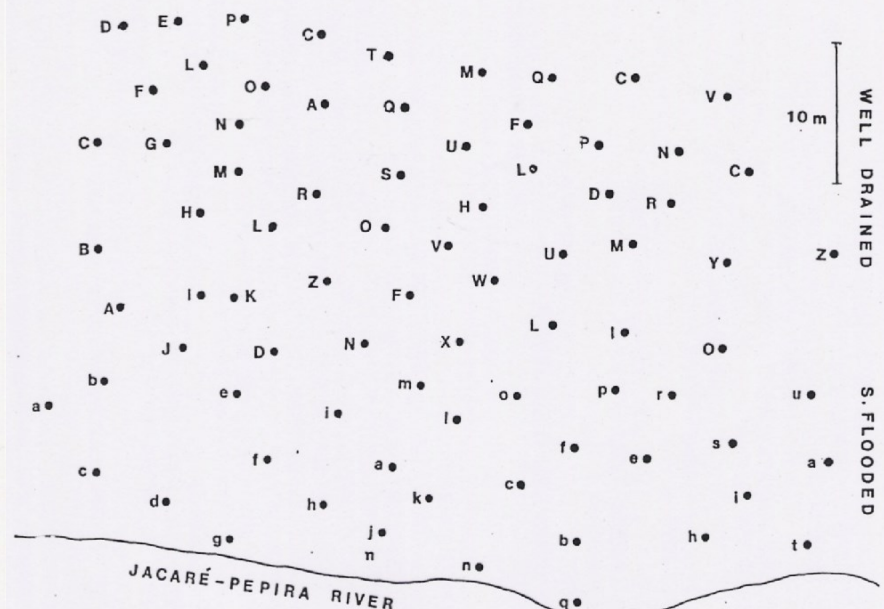


FIGURE 5 - Map of seedling distribution of one of the gallery forest rehabilitation plot in the Jacaré-Pepira watershed, showing a seasonally flooded and a well drained area. (Adapted from SPIGOLON et al, 1989).

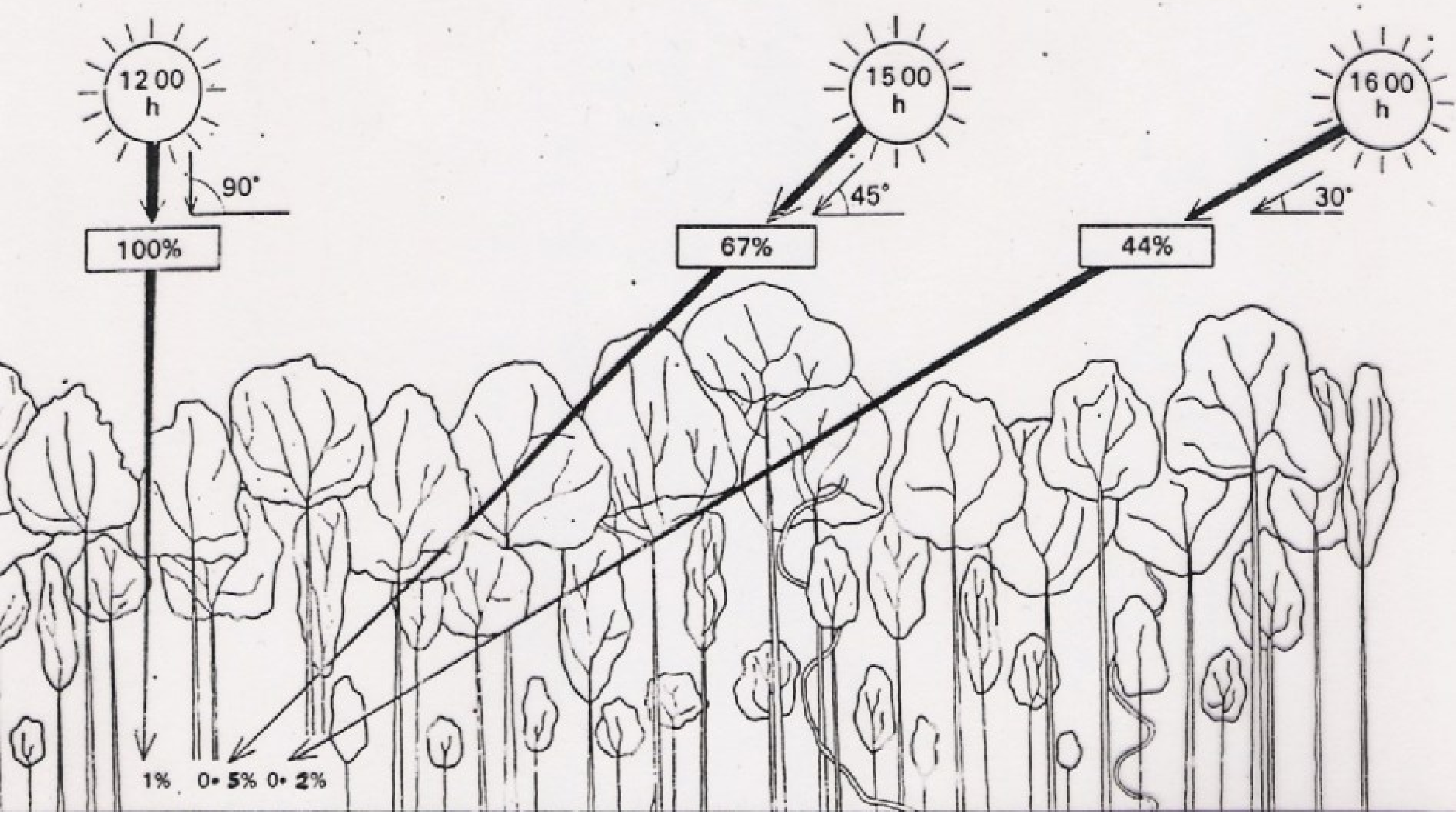
Seasonally flooded area: a - Enterolobium contortisiliquum; b - Tapirira guianensis; c - Genipa americana; d - Campomanesia guazumaefolia; e - Chorisia speciosa; f - Tabebuia avellanedae; g - Inga affinis; h - Calophyllum brasiliense; i - Copaifera langsdorffii; j - Talauma ovata; k - Arecastrum romanzoffianum; l- Myroxyllum peruiferum; m - Cabralea canjerana; n - Syzygium comunis; o - Cariniana estrelensis; p - Eugenia uniflora; q - Erythrina cristagalli; r - Hymenaea courbaril; s - Ocotea elegans; t - Ficus citrifolia; u - Aspidosperma cylindrocarpon.

Well drained area: A - Astronium graveolens; B - Aspidosperma ramiflorum; C - Shyzolobium parahyba; D - Jacaranda macrantha; E - Vochysia tucanorum; F - Cordia superba; G - Rollinia silvatica; H - Tabebuia chrysotricha; I - Aspidosperma cylidrocarpum; J - Pseudobombax grandiflorum; K - Cariniana estrelensis; L - Centrolobium tomentosum; M - Enterolobium contortisiliquum; N - Zeyhera tuberculosa; O - Chorisia speciosa; P - Copaifera langsdorffii; Q - Holocalix balansae; R - Cedrella fissilis; S - Rapanea ferruginea; T - Gallesia gorazema; U - Esenbeckia leiocarpa; V - Peltophorum dubium; W - Lafoensia pacari; X - Nectandra saligna; Y - Machaerium villosum; Z - Pithecelobium edwallii.



Exemplos de Estresse

Quantidade de luz


12 00 h
90°
100%
15 00 h
45°
67%
16 00 h
30°
44%
1%
0• 5%
0• 2%

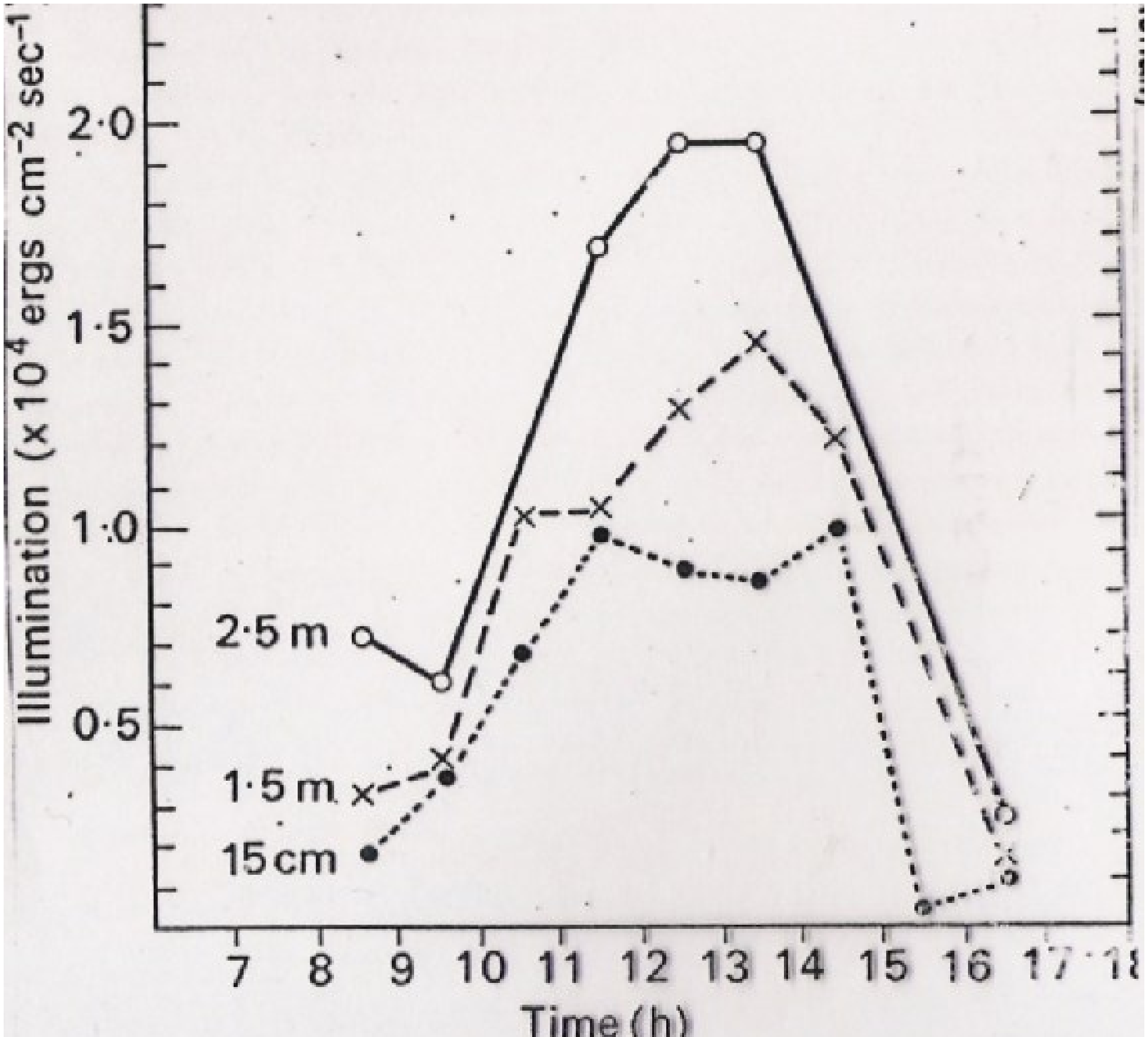
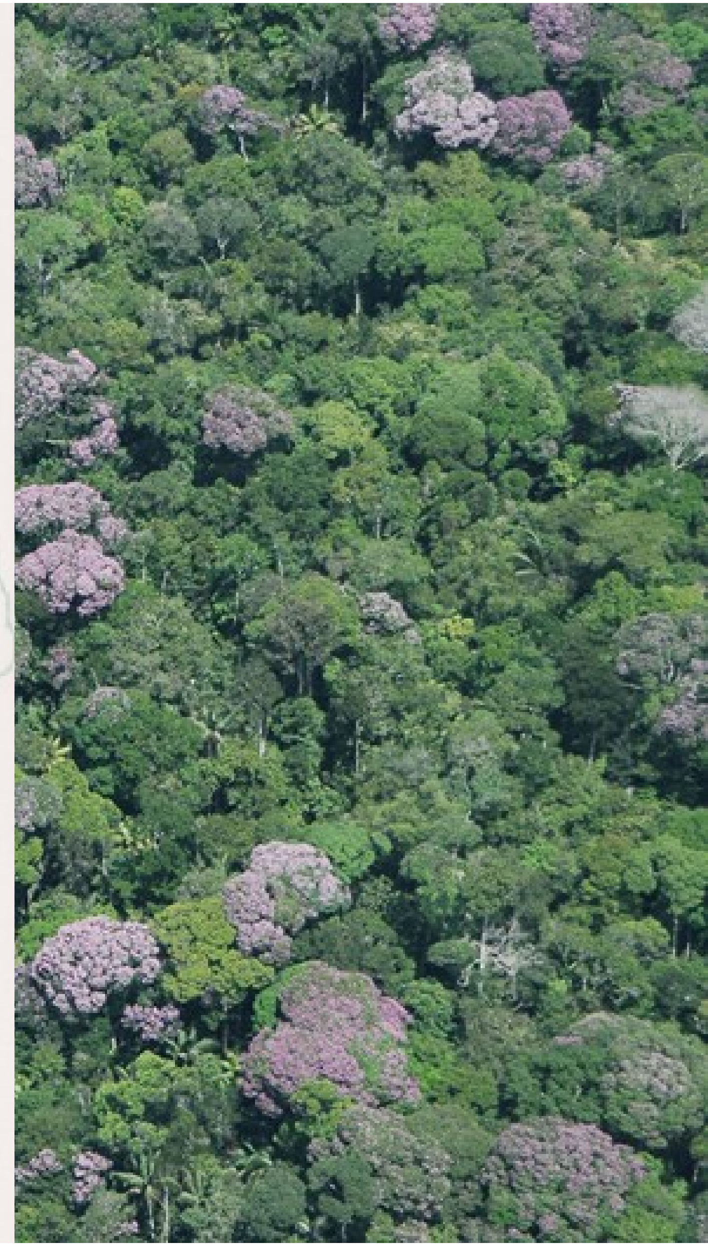
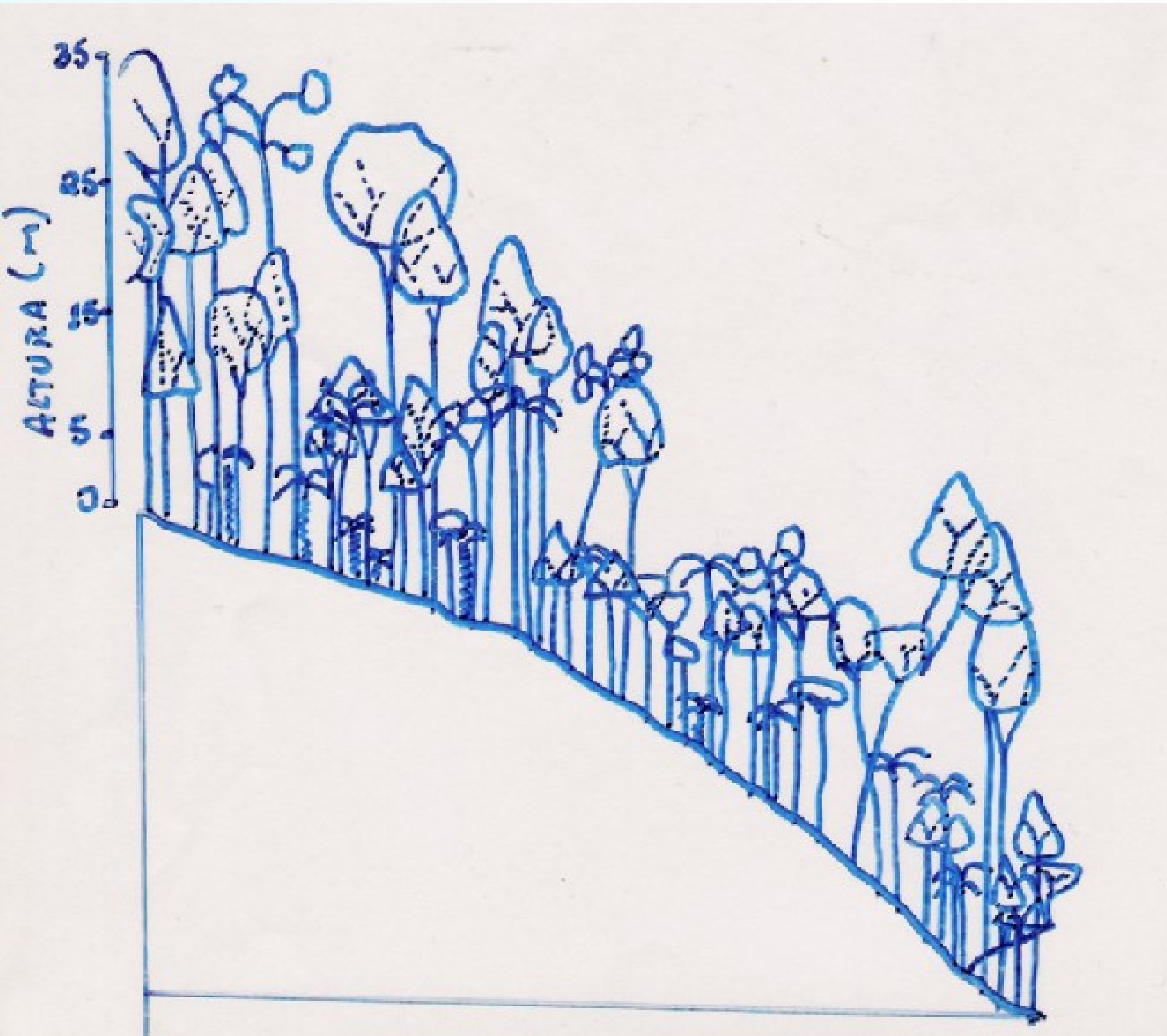
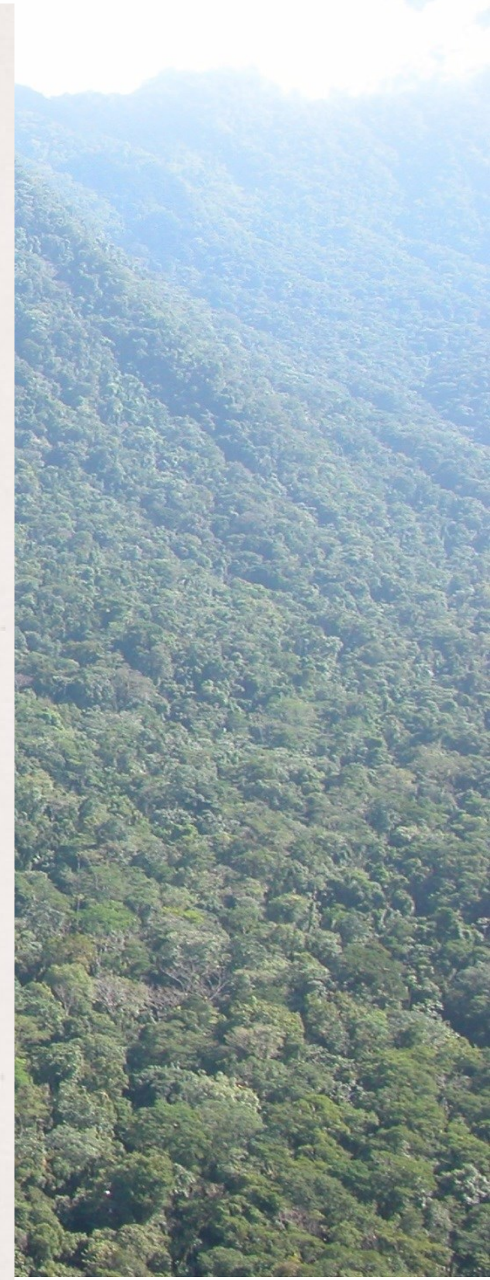


Fig. 3.6 Daily march of illumination in a rain forest in Surinam


ALTURA (m)
35
25
15
5
0


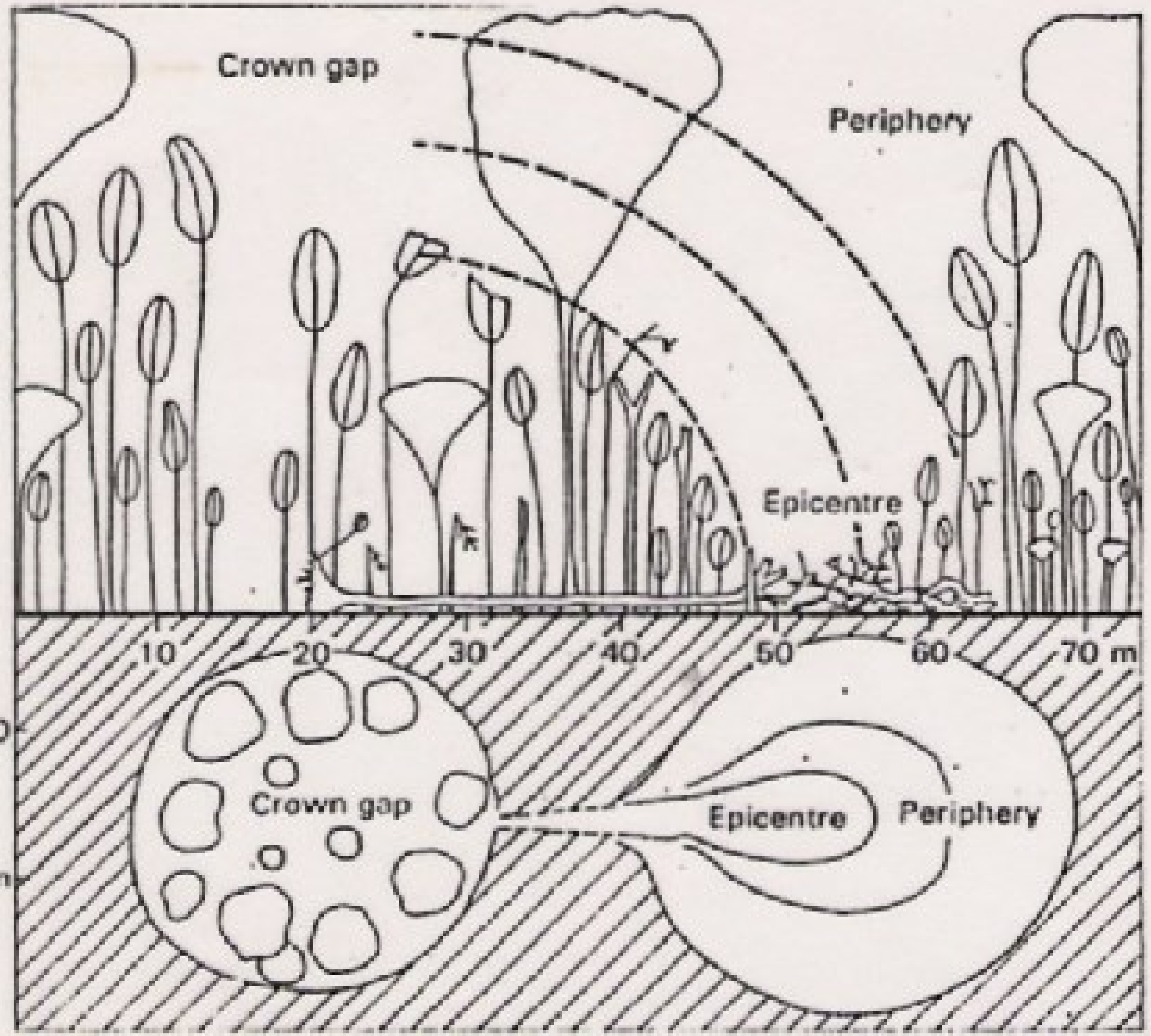


Fig. 6.13 Vertical and horizontal projections of a *chablis*. (After Oldeman 1978.)

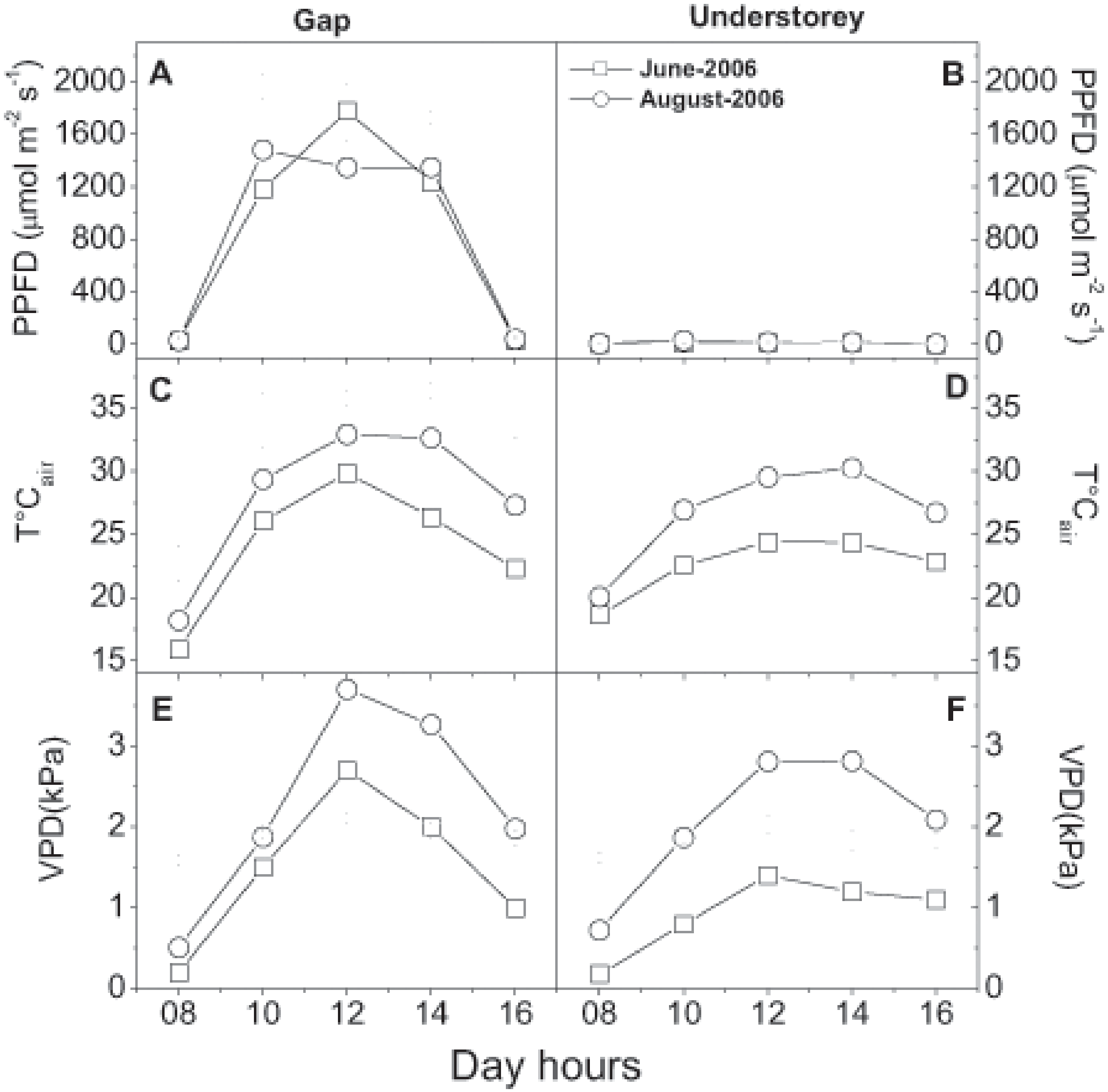


Figure 1. Daily courses of photosynthetic photon flux density (PPFD), air temperature (T_{air}) and vapor pressure deficit (VPD) in the gap (**A, C, E**) and in the understorey (**B, D, F**) in June (squares) and August (circles) 2006.

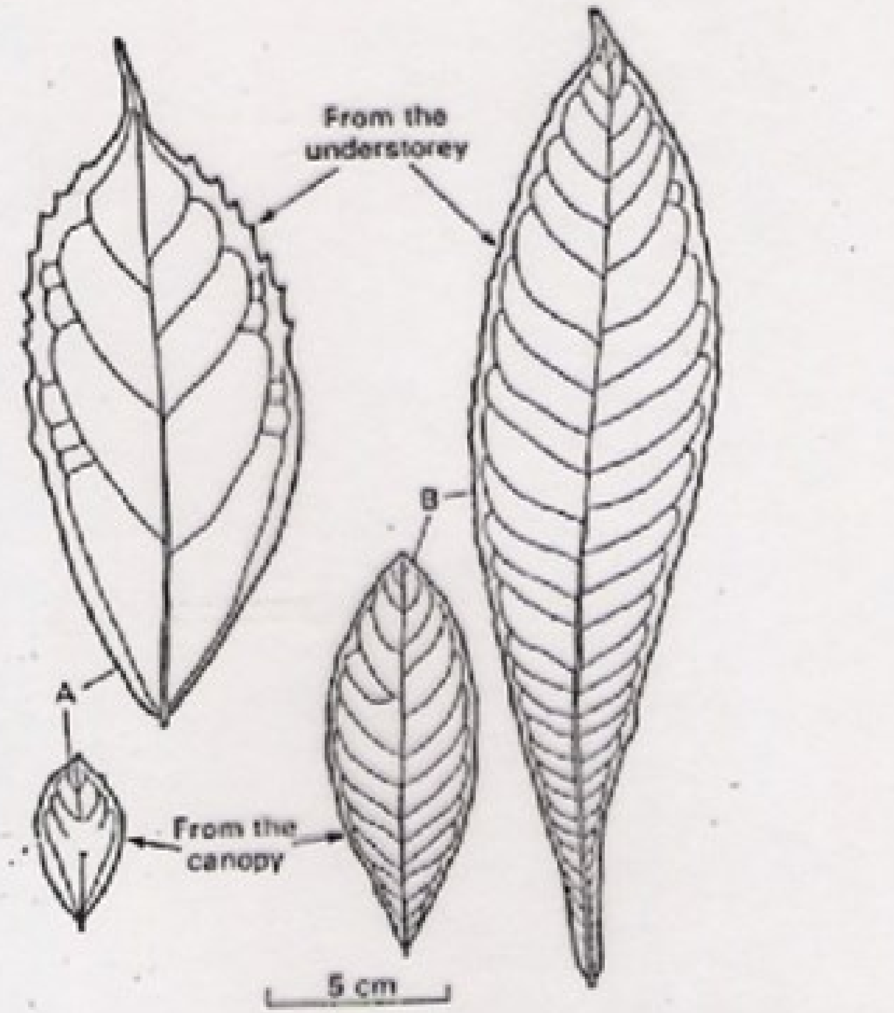
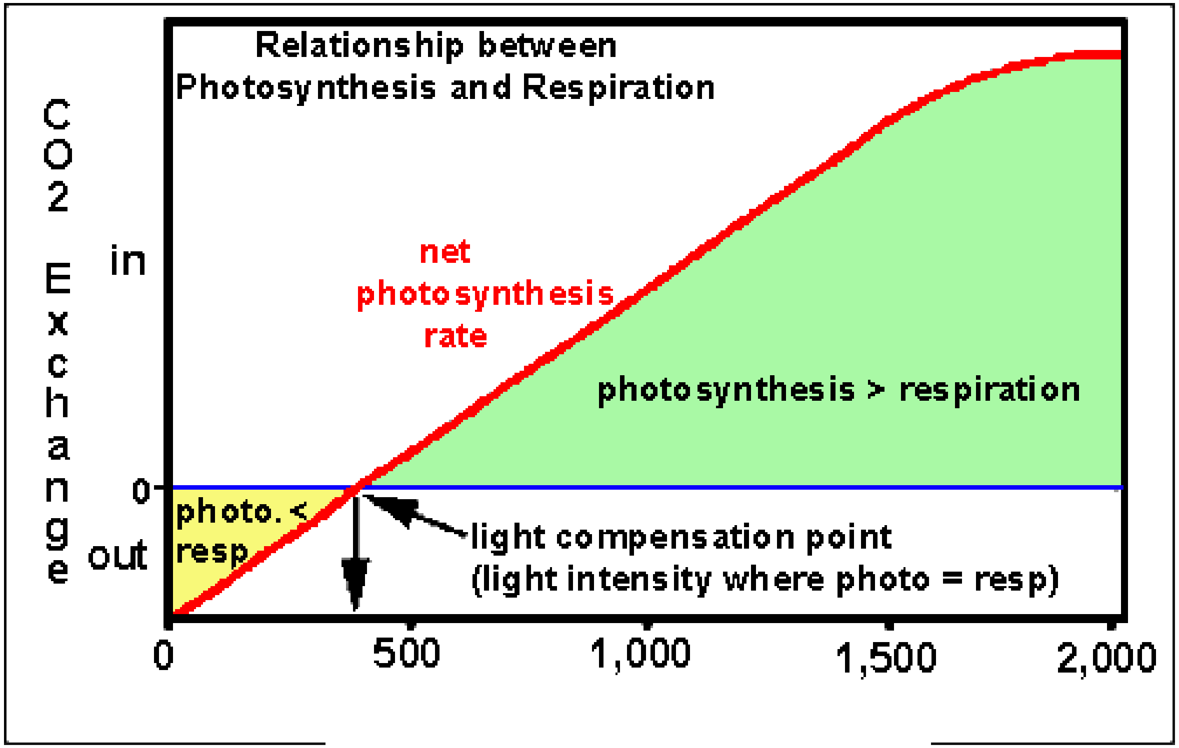
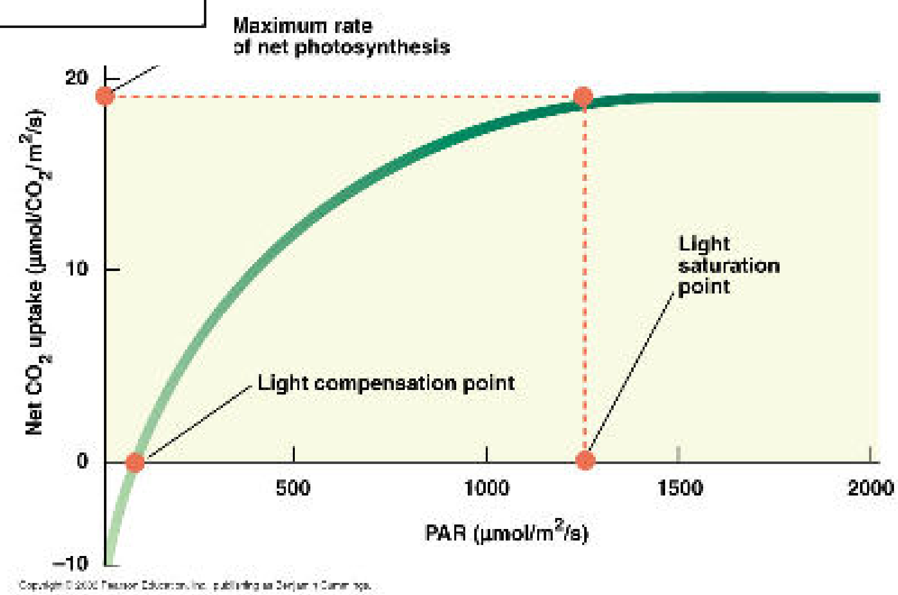
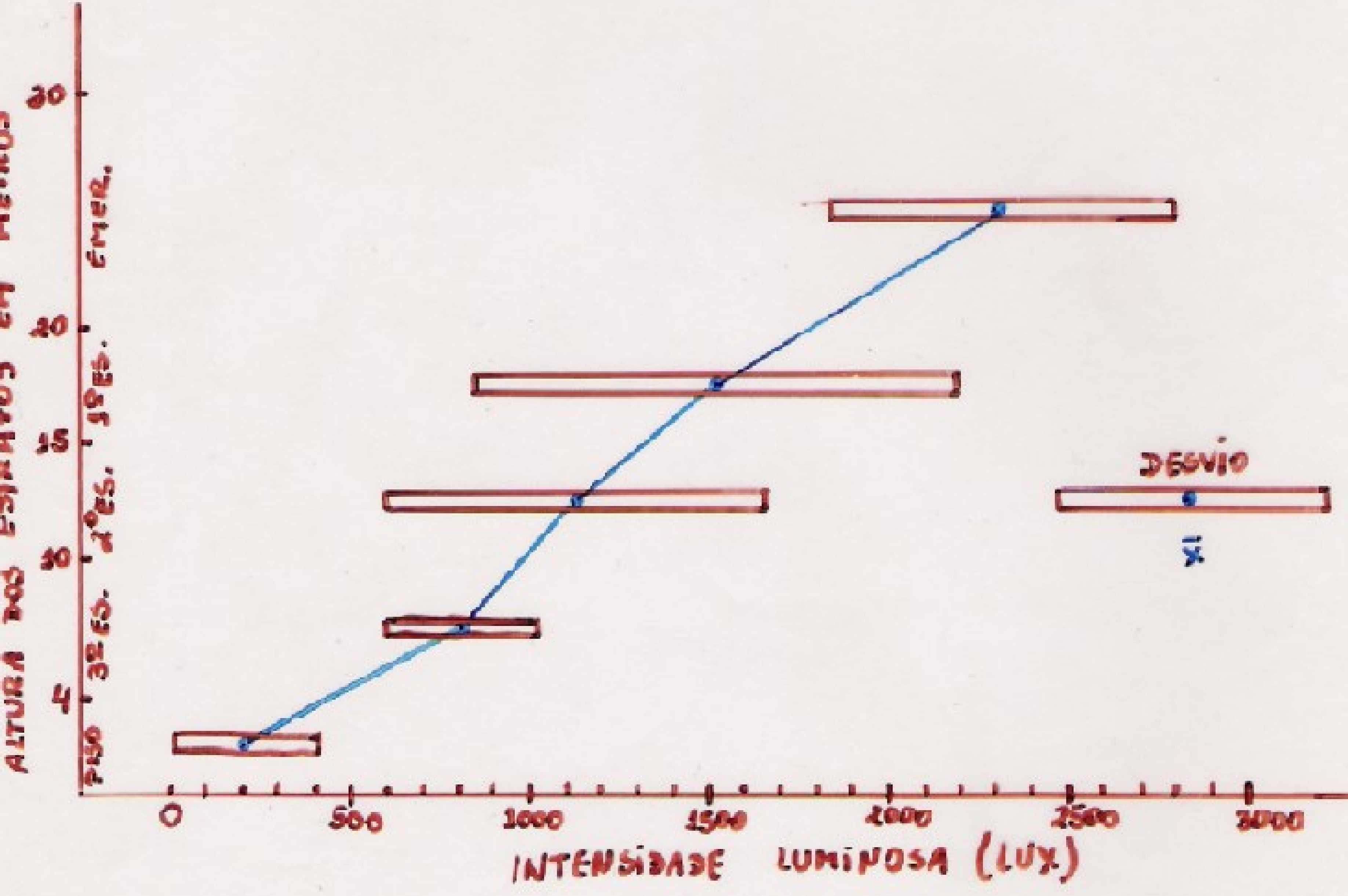
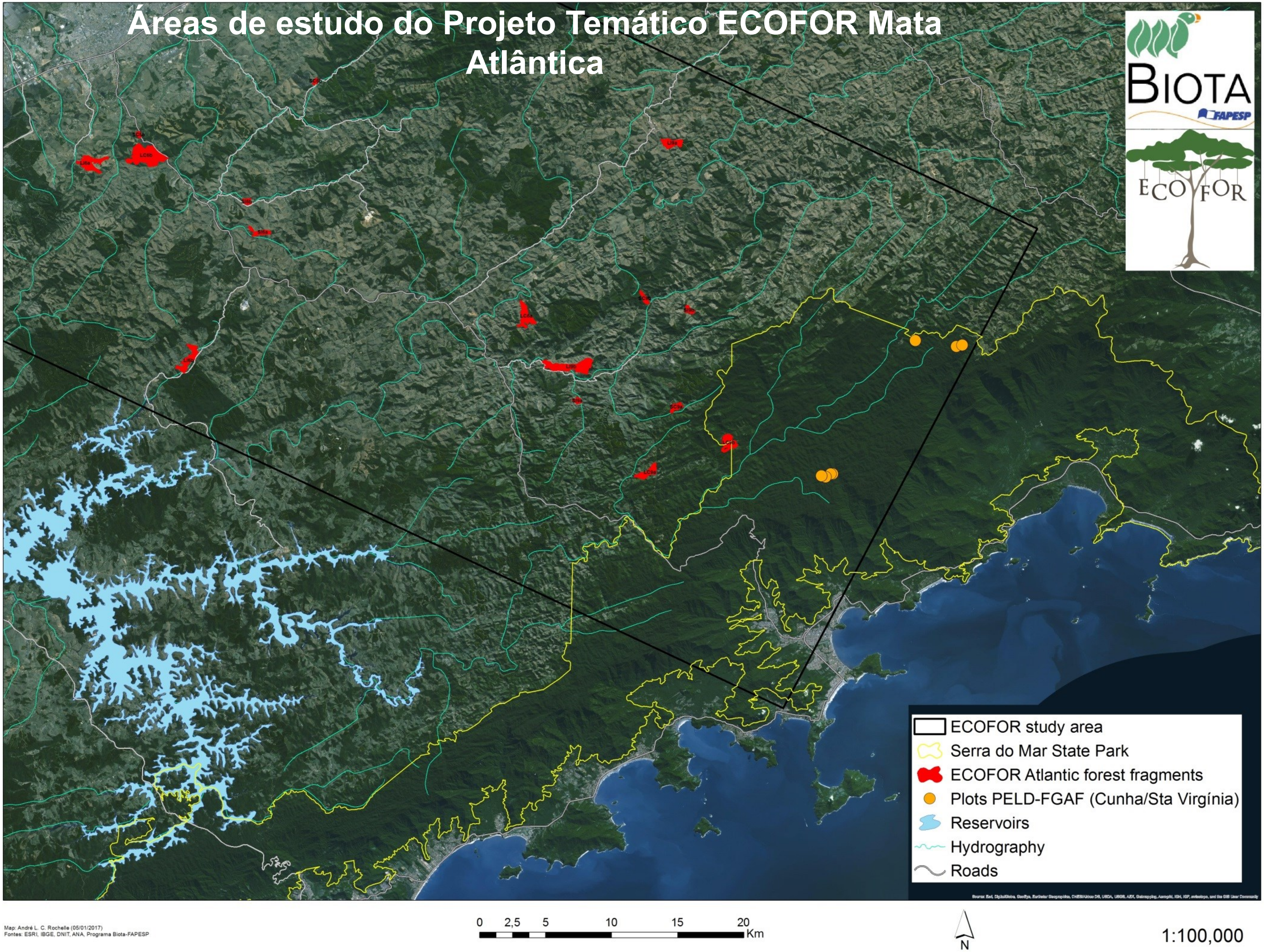


Fig. 5.20 Leaves from the canopy and the understorey of a Ghanaian forest:
(A) *Celtis mildbraedii*, a large tree; and (B) *Hugonia platysepala*, a liane. (From Hall and Swaine 1981.)


Relationship between
Photosynthesis and Respiration
CO2 Exchange
in
out
0
net
photosynthesis
rate
photosynthesis > respiration
photo. <
resp
light compensation point
(light intensity where photo = resp)
0
500
1,000
1,500
2,000


Maximum rate
of net photosynthesis
Net CO2 uptake (µmol/CO2/m2/s)
20
10
0
−10
Light
saturation
point
Light compensation point
500
1000
1500
2000
PAR (µmol/m2/s)


ALTURA DOS ESTRATOS EM METROS
30
20
15
10
PISO
3º ES.
2º ES.
1º ES.
EMER.
DESVIO
0
500
1000
1500
2000
2500
3000
INTENSIDADE LUMINOSA (LUX)



Map: André L. C. Rochelle (05/01/2017)
Fontes: ESRI, IBGE, DNIT, ANA, Programa Biota-FAPESP

Metodologias para coleta de dados de luz e temperatura

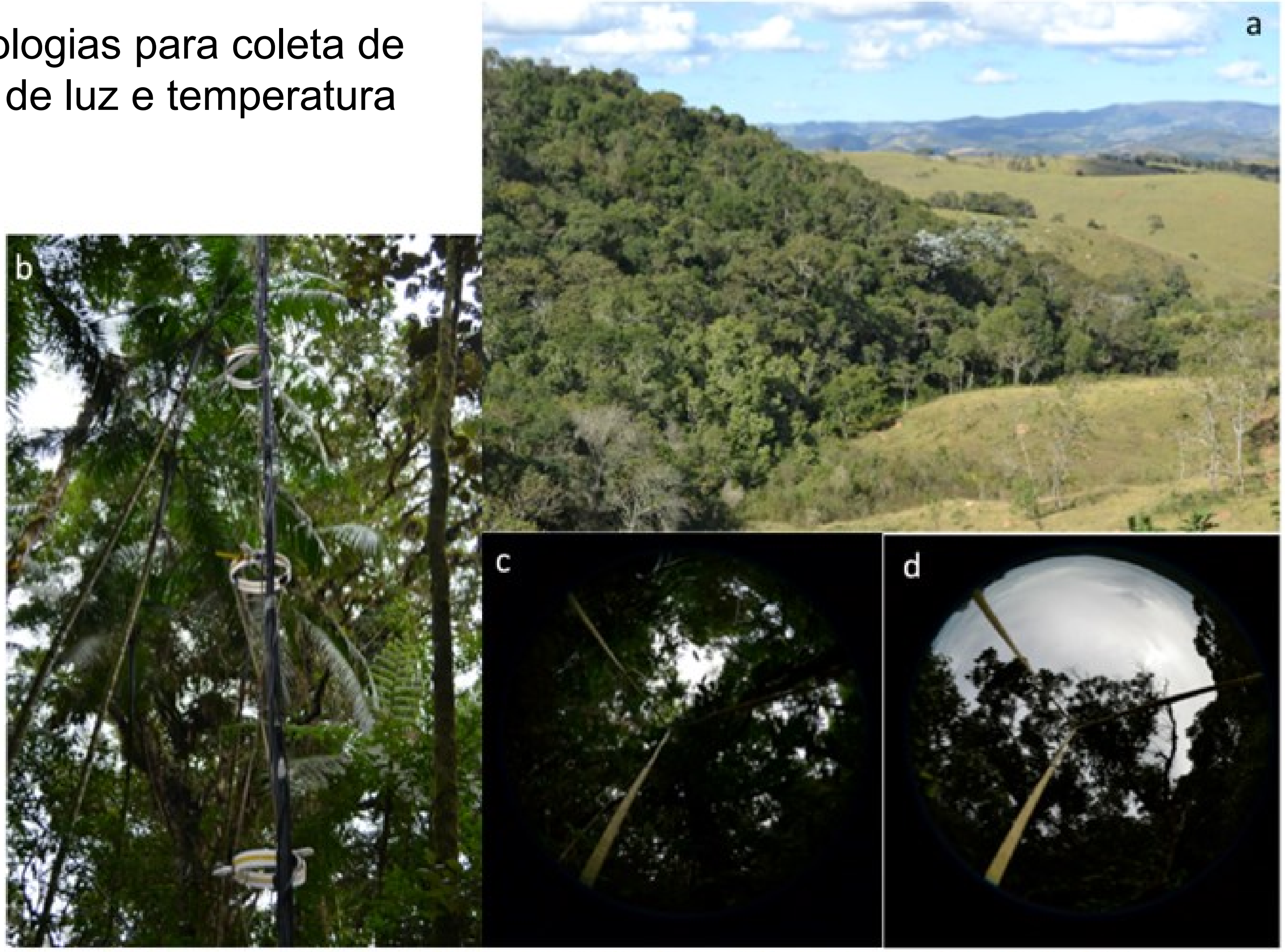


Figure 1. Images of data collection. a) The forest fragment at Lagoinha, b) a section of three light sensors and cables suspended on plastic rings from a tree in Parque Estadual Serra do Mar, c) example hemispherical photograph taken at the 2 m above the forest floor and d) example hemispherical photograph taken at 18 m above the forest floor at the same sample point as c).

Fauset *et al* submitted Ecosphere

Perfil da quantidade de luz que penetra em florestas com diferentes características de manejo

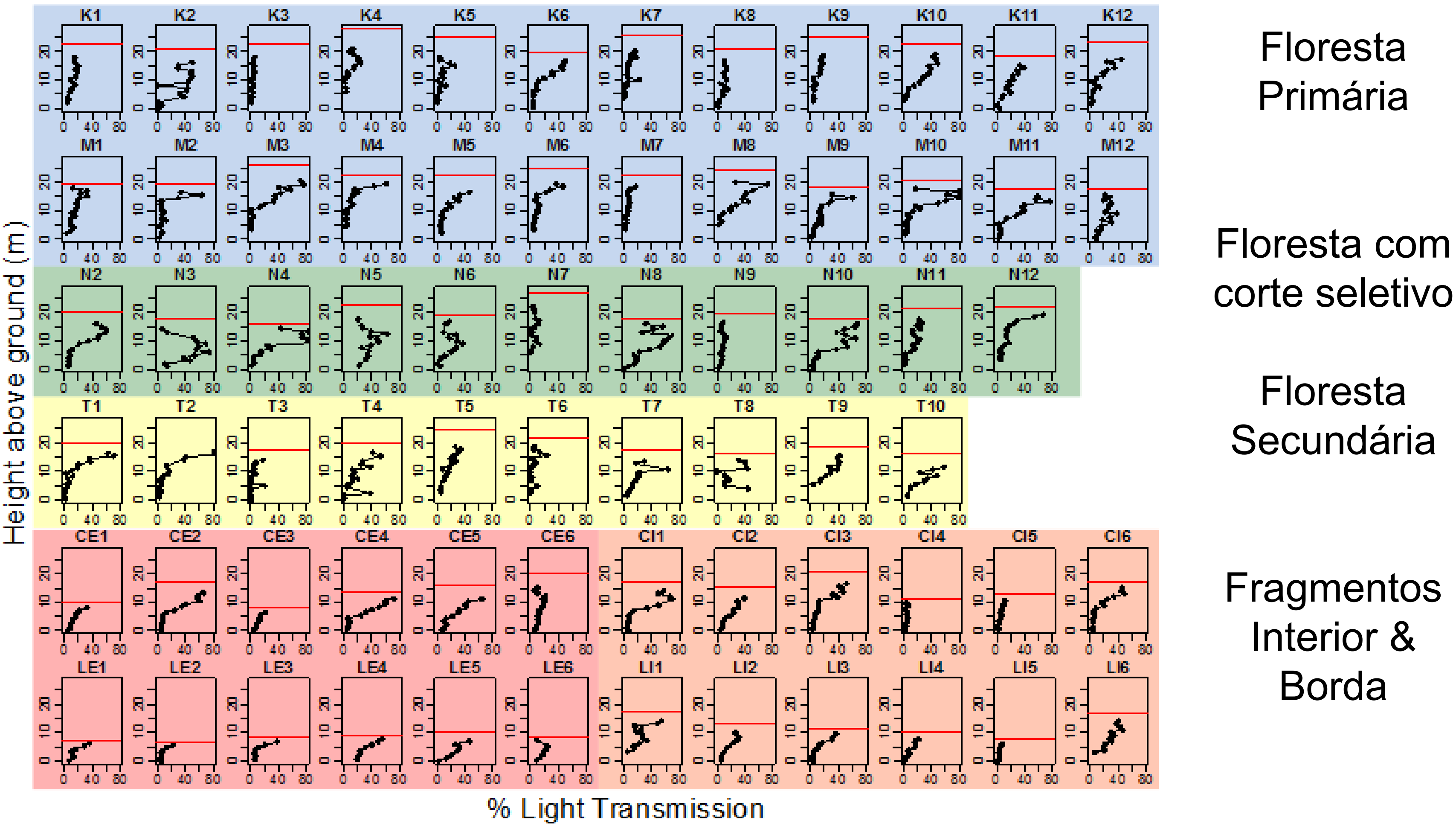


Figure 2. Light profiles from each sampled tree. Colours show different levels of forest degradation: blue – old growth, green – logged, yellow – secondary, orange – fragment interior, red – fragment edge. Red lines show the estimated canopy height of the sampled tree.

Fauset *et al* submitted Ecosphere

Perfil de temperatura em florestas com diferentes características de manejo

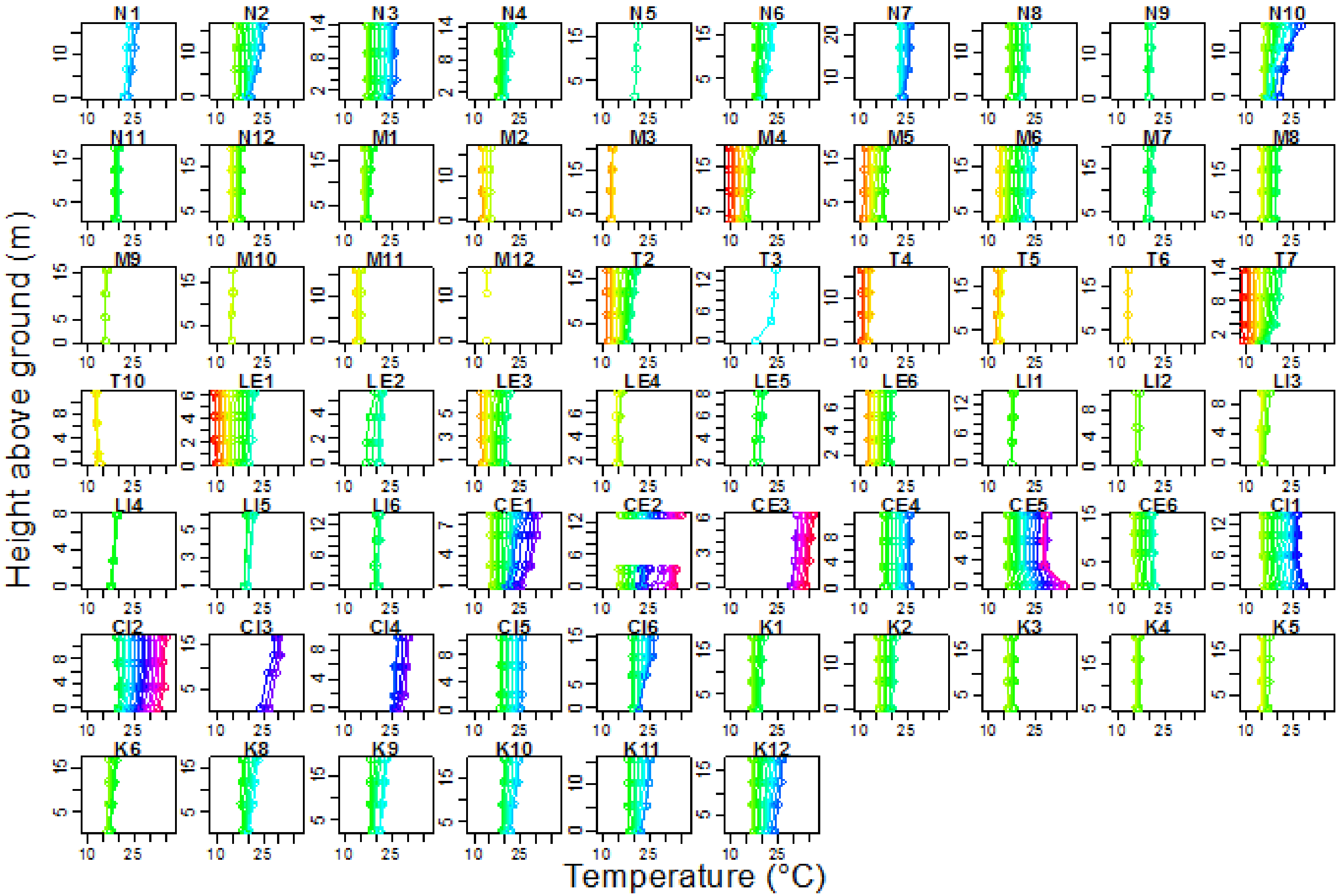


Figure 5. Temperature profiles. The colours represent data binned different 1°C intervals, based on the temperature at the top of the profile.

Fauset *et al* submitted Ecosphere

Relação entre o diâmetro do caule e o tamanho da copa

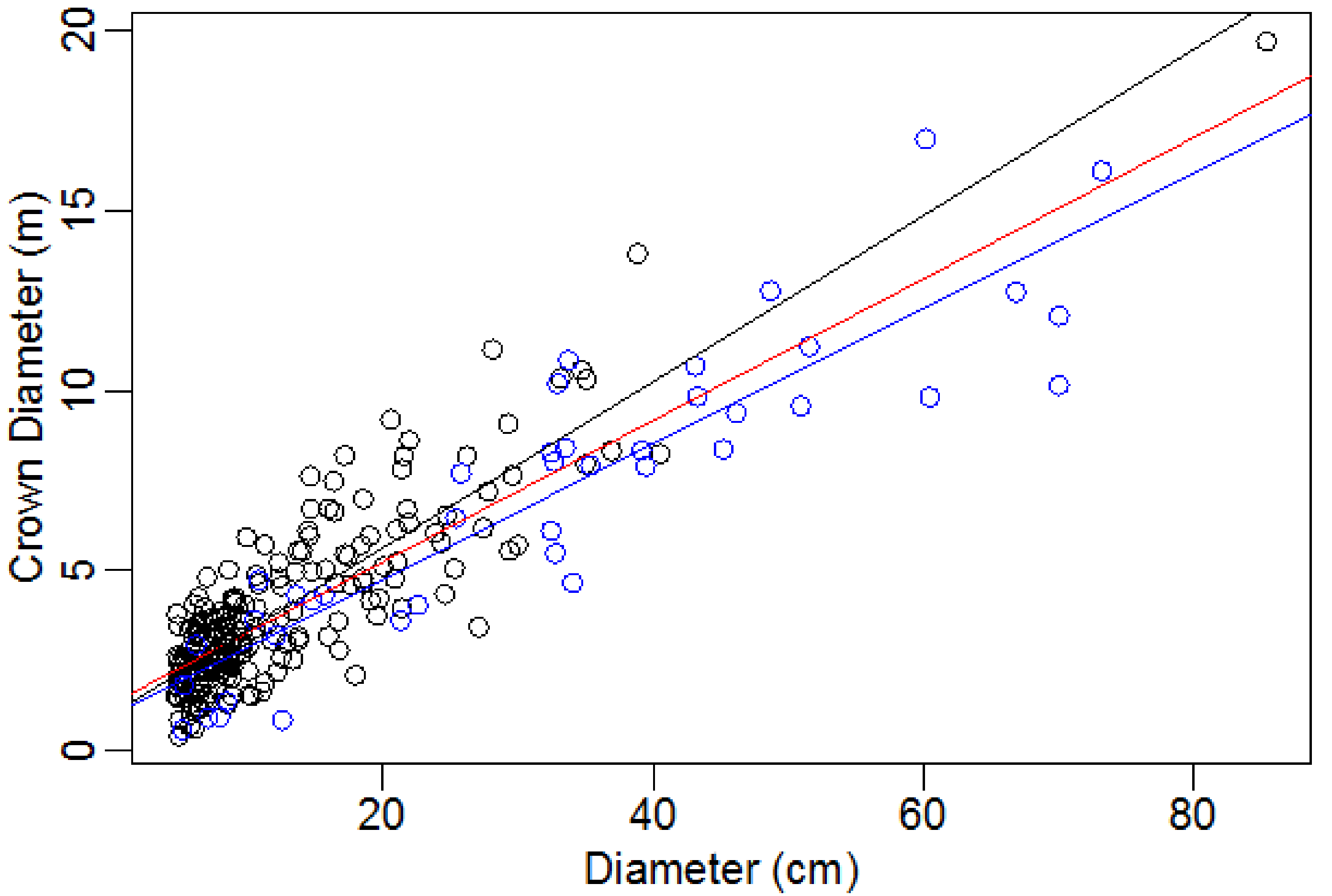


Figure 6. Allometry between tree diameter and crown diameter. Black points – data from fragment, blue points – data from continuous forest, red line – regression line based on all data, blue line – regression line based on continuous forest data, black line – regression line based on fragment data.

Fauset *et al* submitted Ecosphere

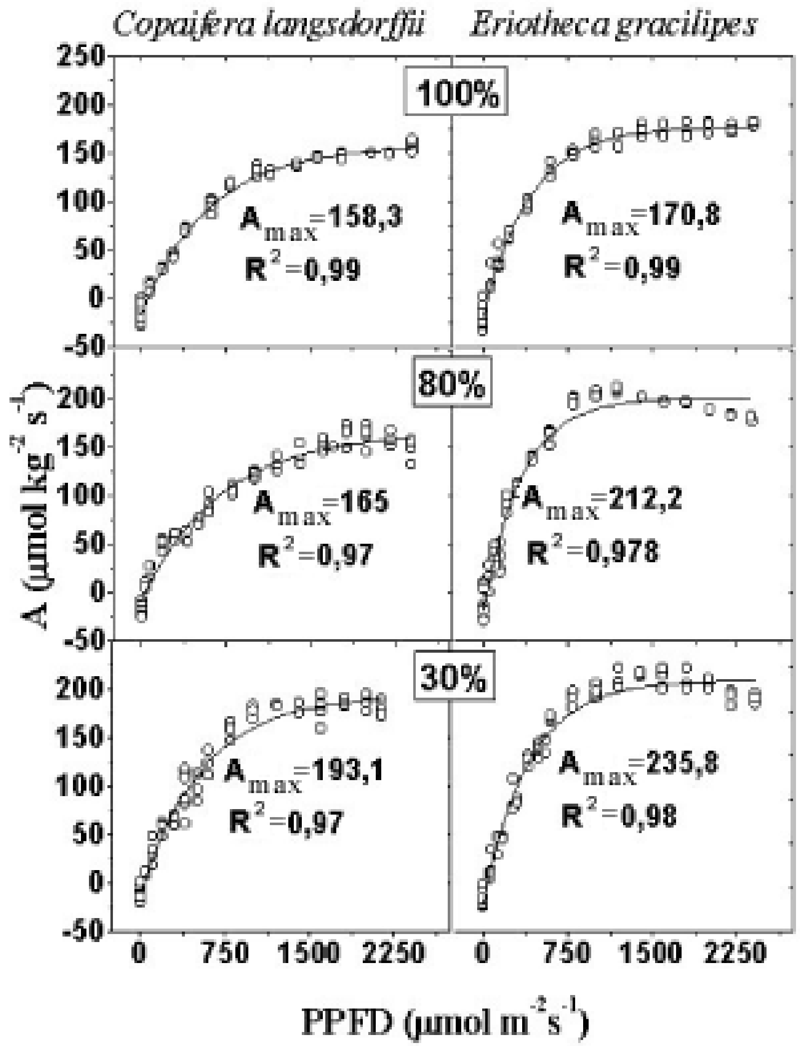
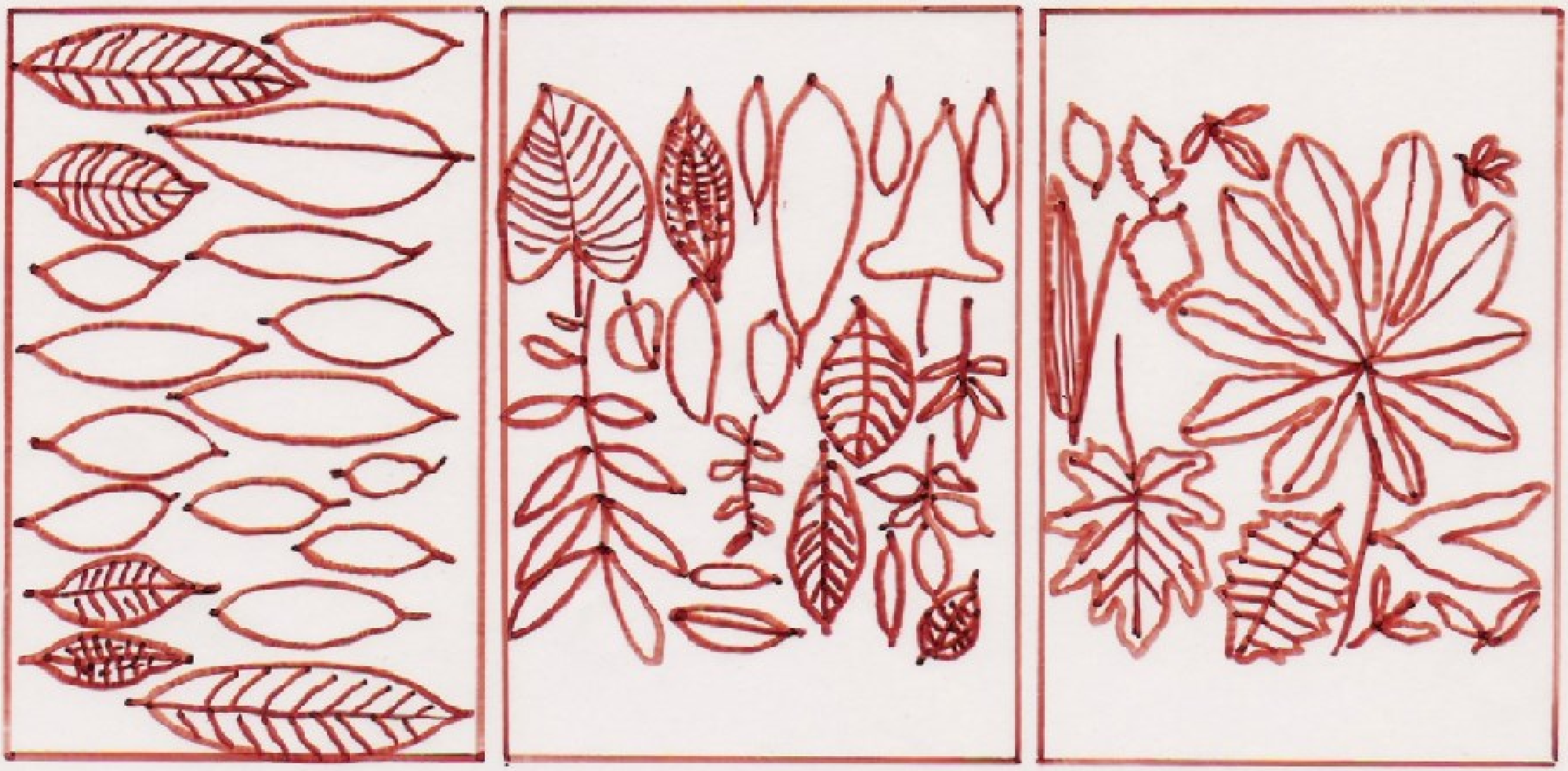
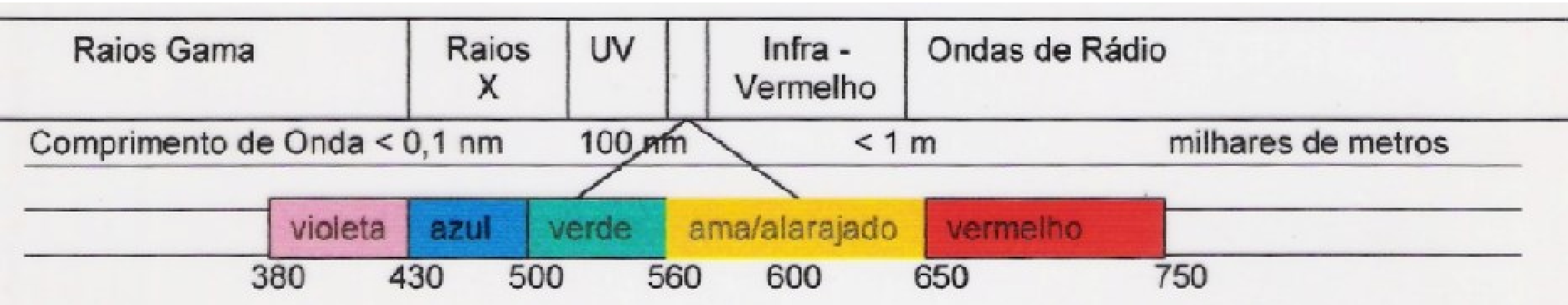


Figure 2 - Net photosynthesis (A) expressed on mass bases (A_{maxm}, µmol kg^{-1} s^{-1}), as a function of photosynthetic photon flux density (PPFD) in totally expanded leaflet in *Copaifera langsdorffii* and in *Eriotheca gracilipes* at 120 days after sowing and cultivated at 100 (full solar radiation, top), 80 and 30% transmittance.



Exemplos de Estresse

Qualidade da luz



Raios Gama
Raios X
UV
Infra - Vermelho
Ondas de Rádio
Comprimento de Onda < 0,1 nm
100 nm
< 1 m
milhares de metros
violeta
azul
verde
ama/alarajado
vermelho
380
430
500
560
600
650
750

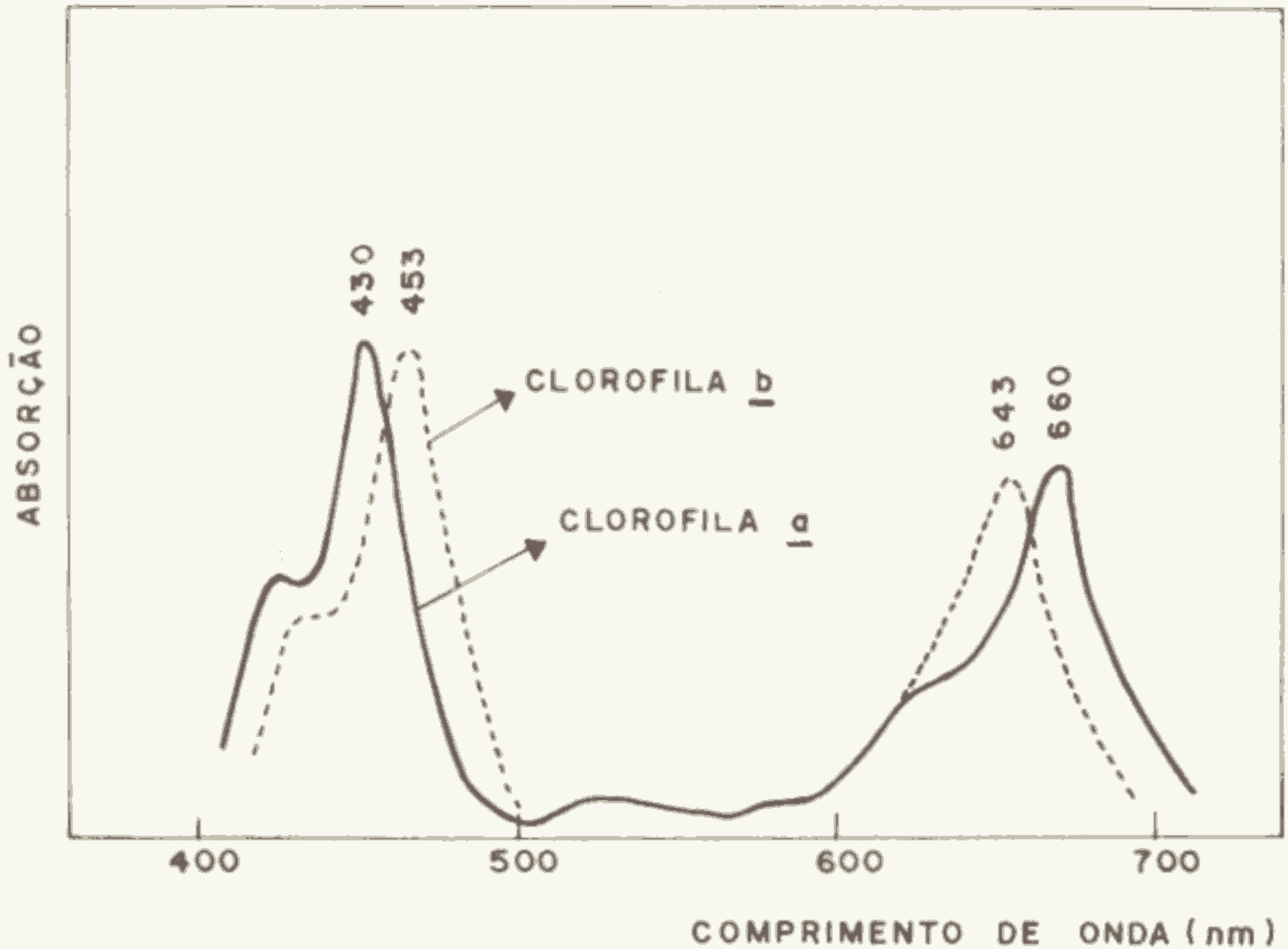


Figura 4. Espectro de absorção das clorofilas *a* e *b*.

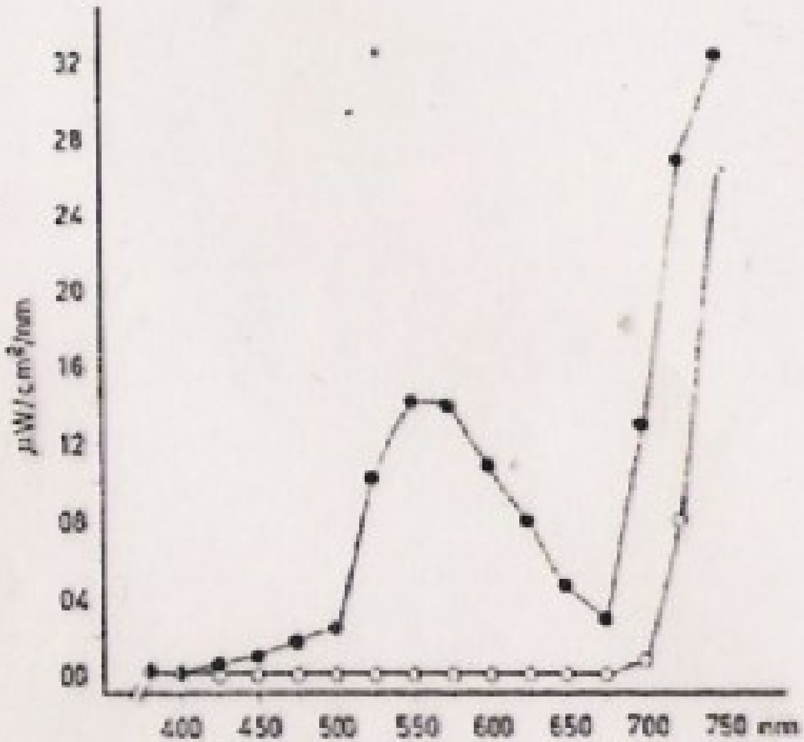
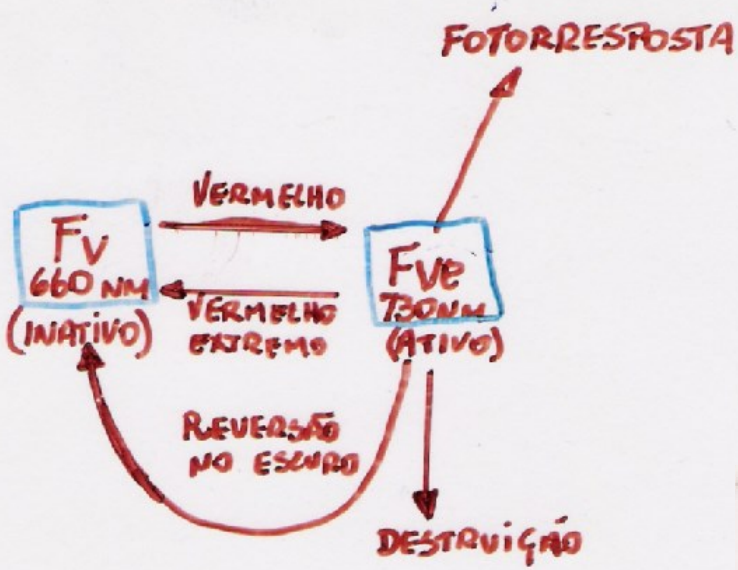


Fig. 3: Light spectra inside and outside the leaf canopy of *Psophocarpus tetragonolobus* (L.) DC.: ○ inside; ● outside. Five replicates of 30 seeds. Results after 20 days of treatment: outside the canopy = 75 %; inside the canopy = 0 % of germination.



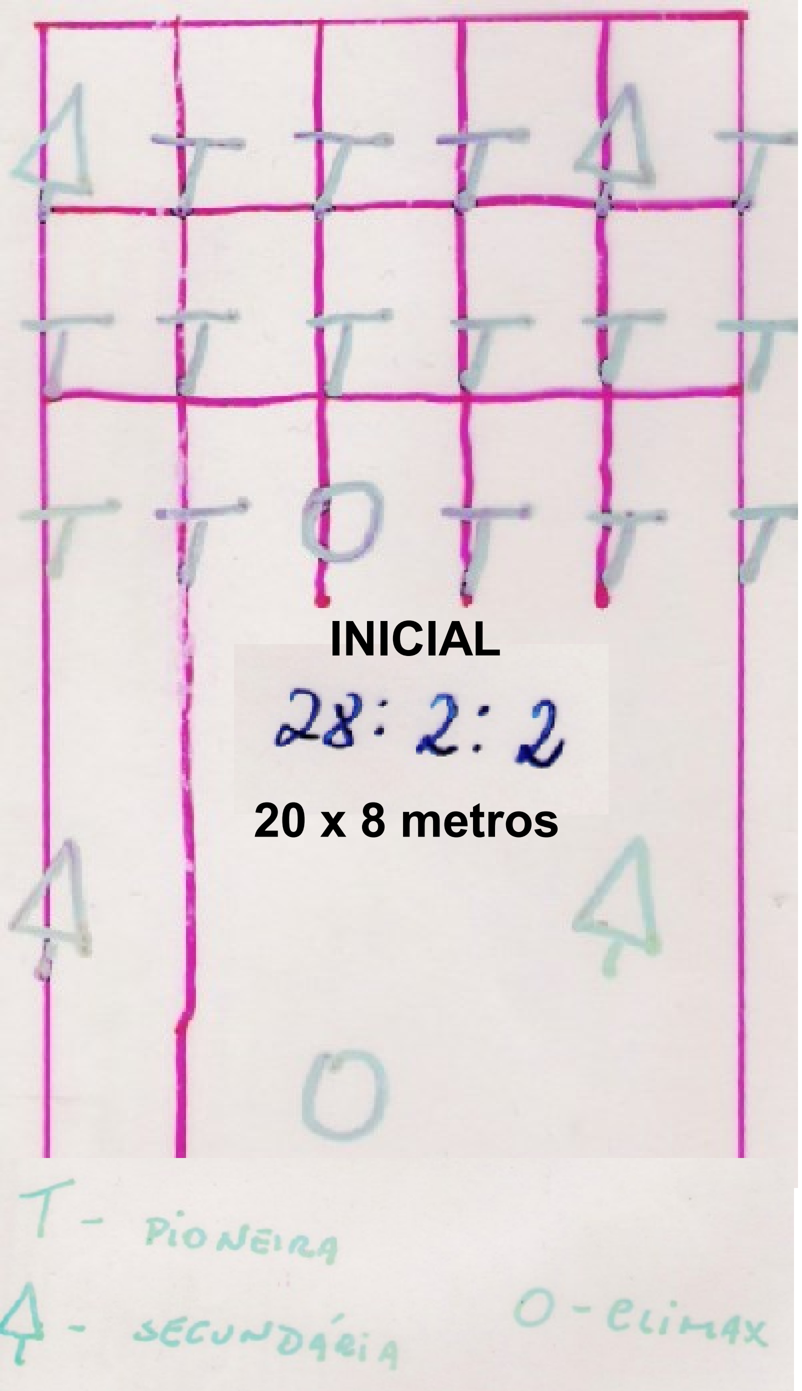
% Germinação de sementes de *Cecropia glaziovii*

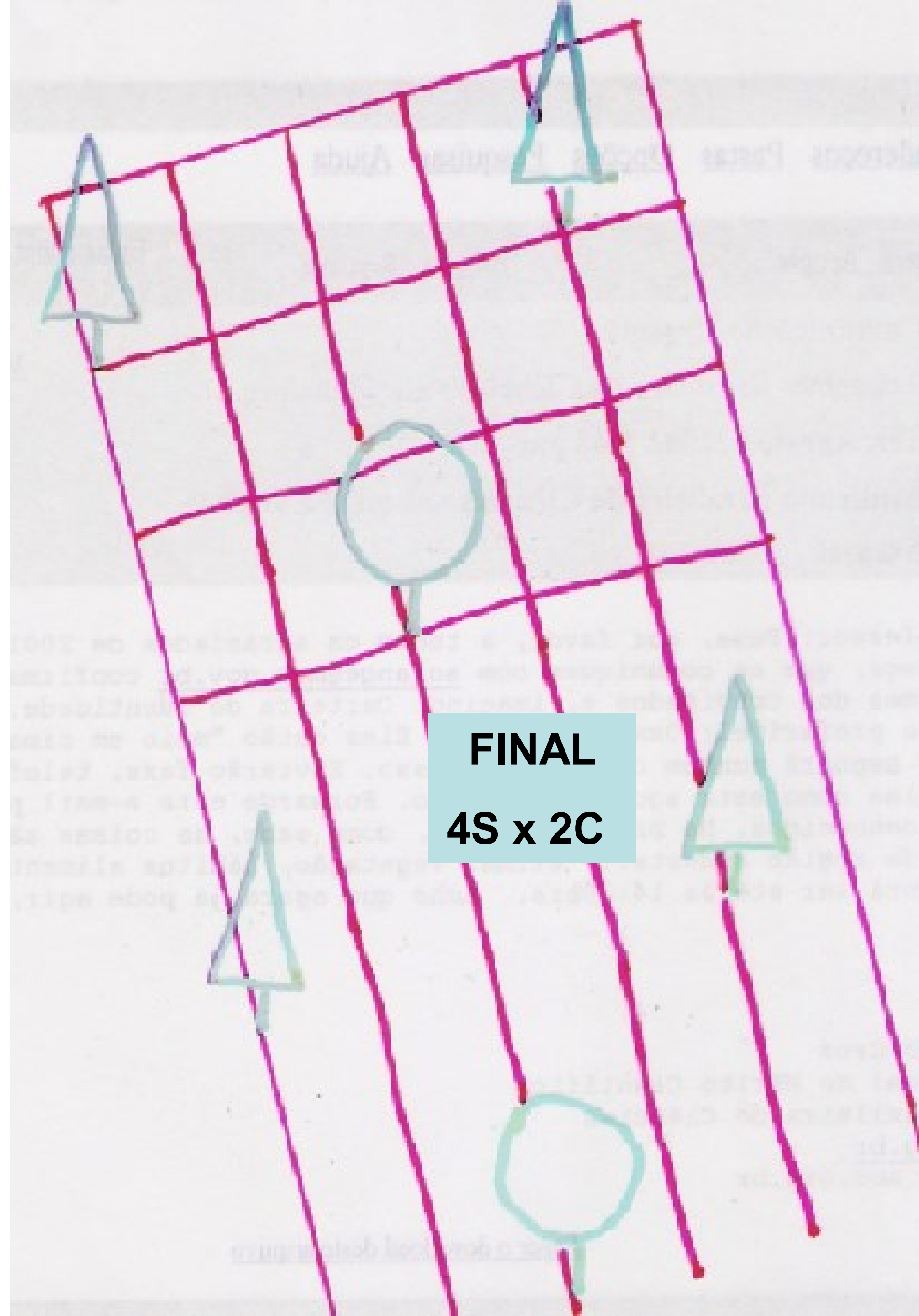
TRATAMENTO	ENERGIA (Ly/Min)	% GERMINAÇÃO
LUZ SOLAR	0.140	86%
1 CAMADA DE ESTOPA	0.034	83%
3 CAMADAS DE ESTOPA	0.000	0%
LUZ VERMELHA	0.136	74%
LUZ VERMELHO-EXTREMO	0.131	0%
FORA DA MATA	—	72%
DENTRO DA MATA	—	0%

PIONEIRAS – Trema micranta, Cecropia cinerea
Croton floribundus

SECUNDÁRIAS – Chorisia speciosa, Tabebuia sp, Centrolobium tomentosum, Cédrella fissilis, Aspidosperma polyneuron, Zeyhera tuberculosa

CLÍMAXES – Hymenaea stilbocarpa, Enterolobium contortisiliquum, Copaífera langsdorfii


INICIAL
28: 2: 2
20 x 8 metros
T - PIONEIRA
- SECUNDÁRIA
O - CLIMAX


FINAL
4S x 2C

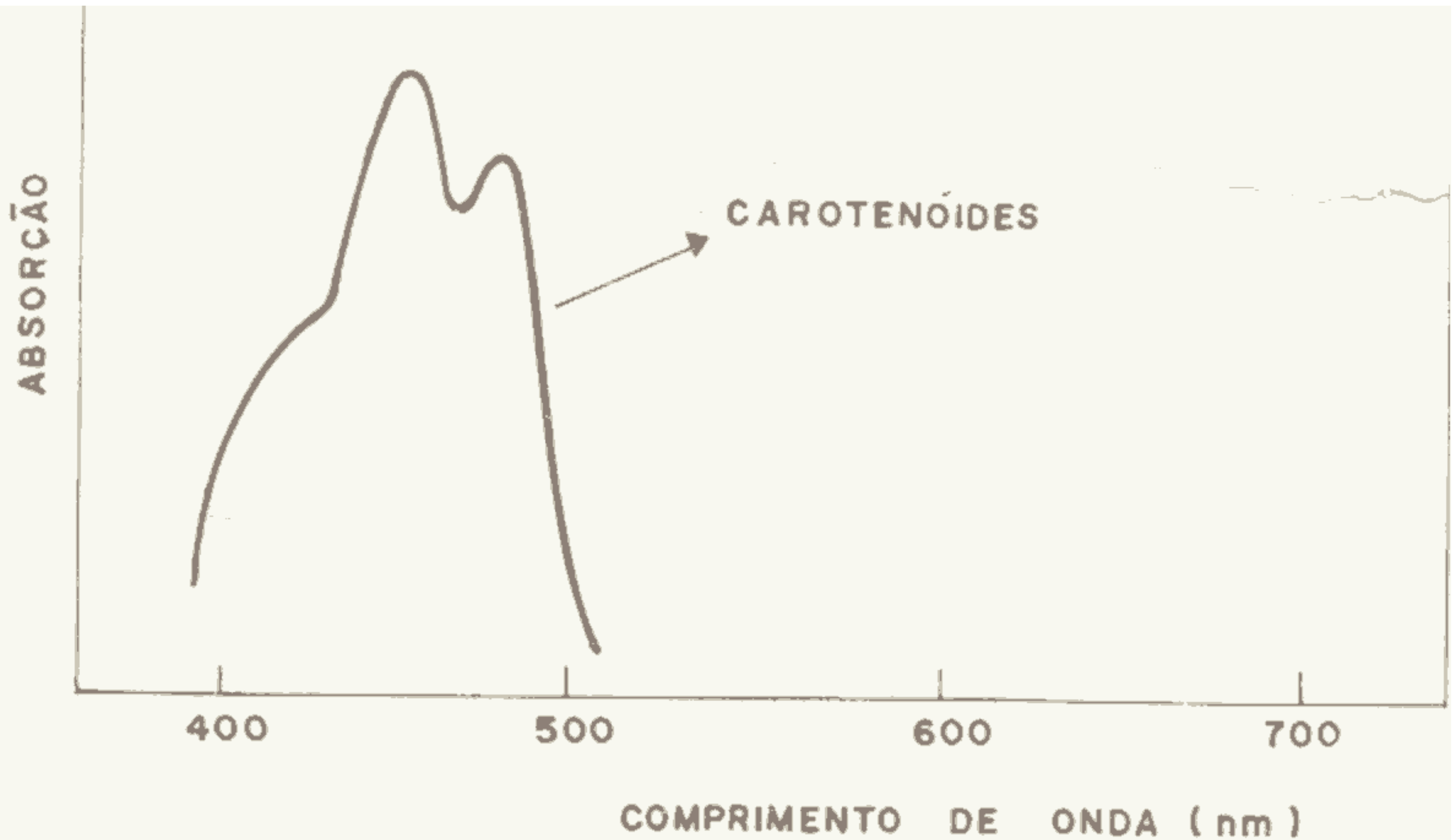


Figura 5. Espectro de absorção dos carotenóides.