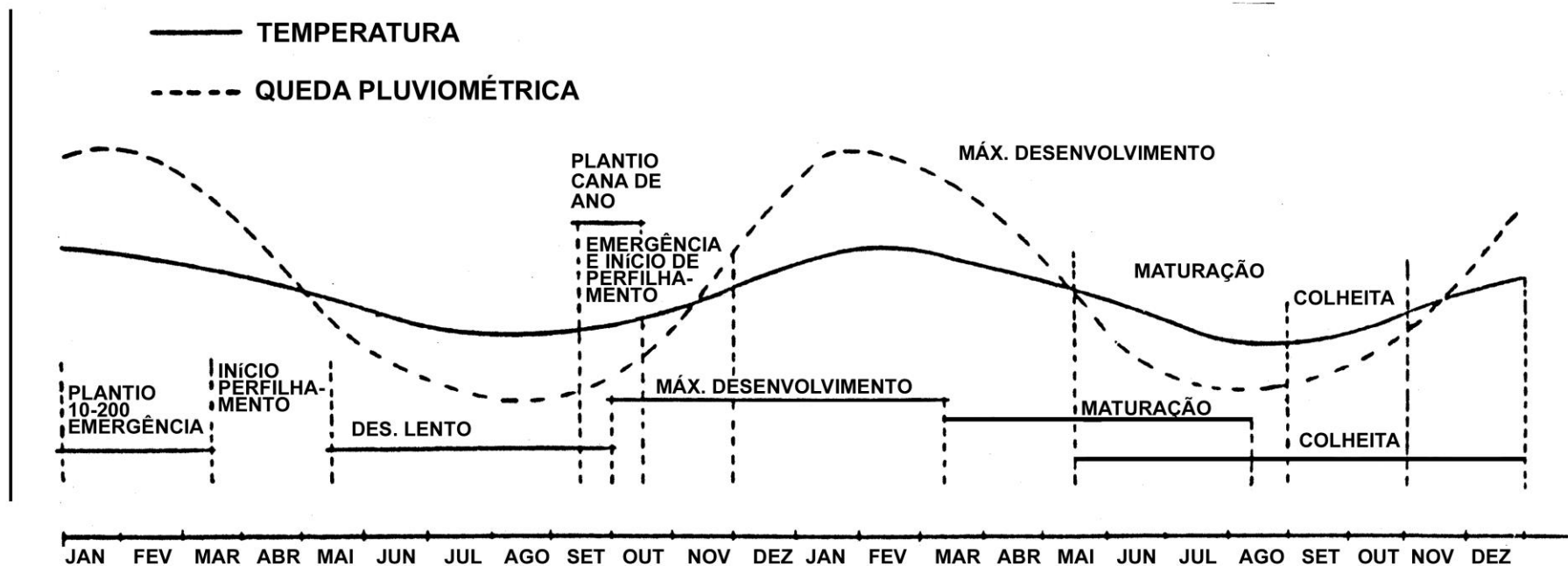


# FISIOLOGIA DE CULTIVOS: CANA-DE-AÇÚCAR

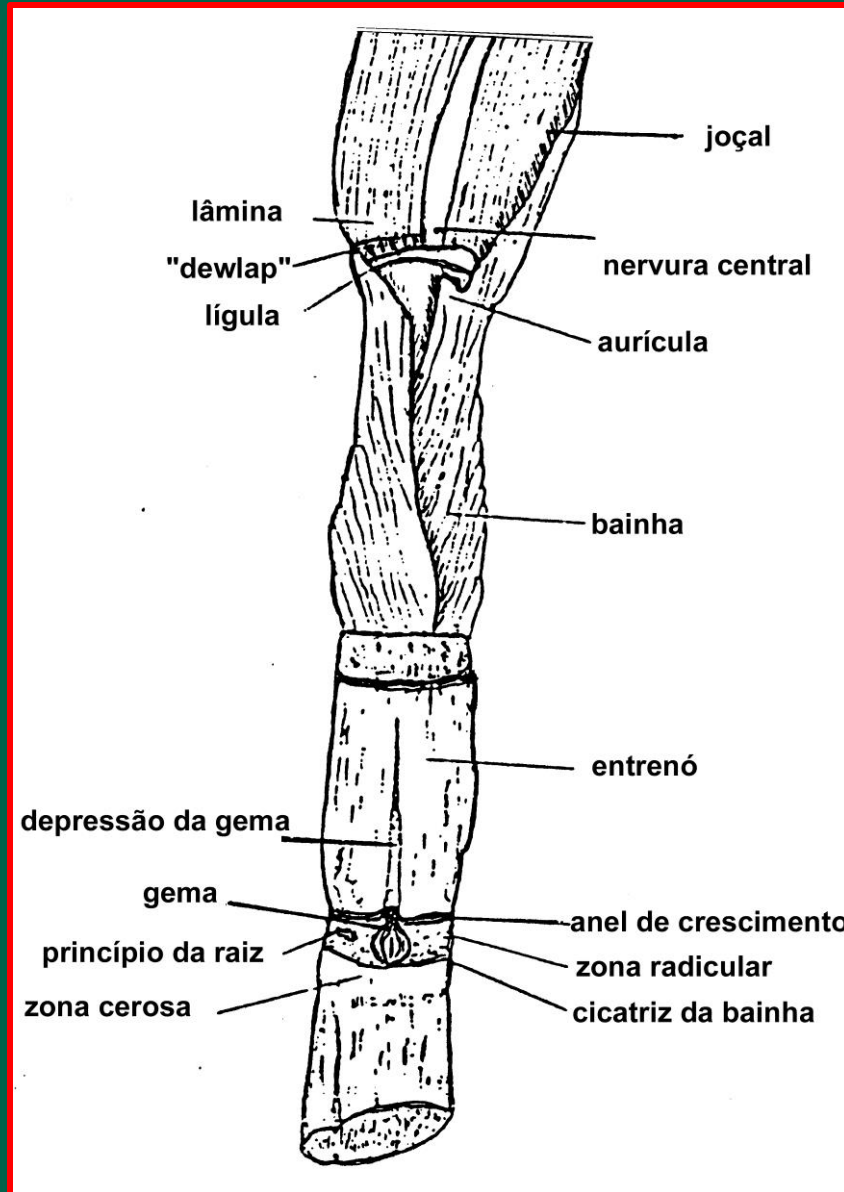


**Paulo Roberto de Camargo e Castro**  
**Professor Titular - ESALQ/USP**

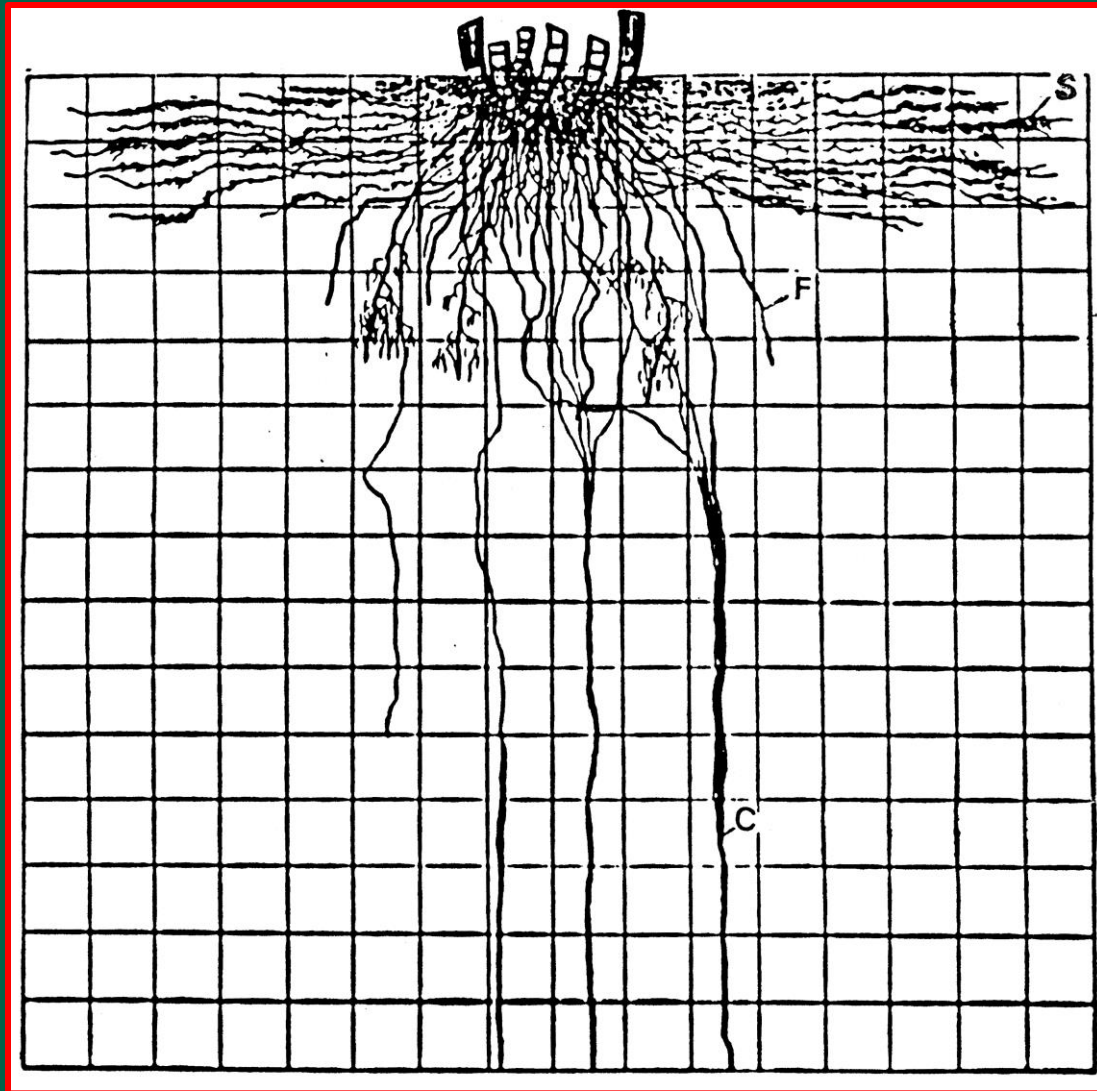
# CICLO DA CANA, TEMPERATURA E CHUVA



# MORFOLOGIA

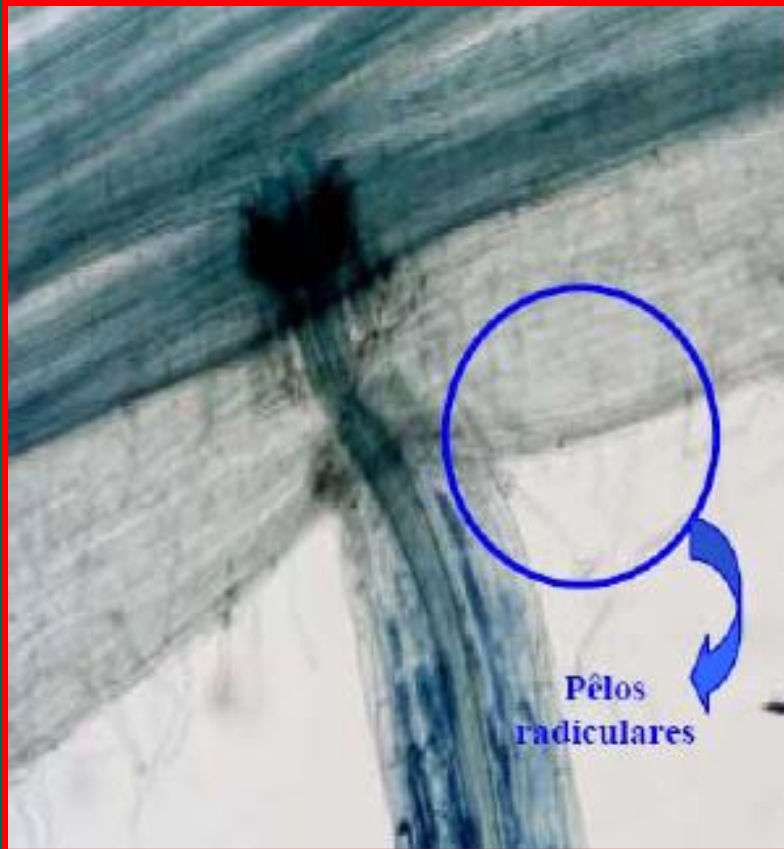


# SISTEMA RADICULAR





# RAIZ DA CANA-DE-AÇÚCAR

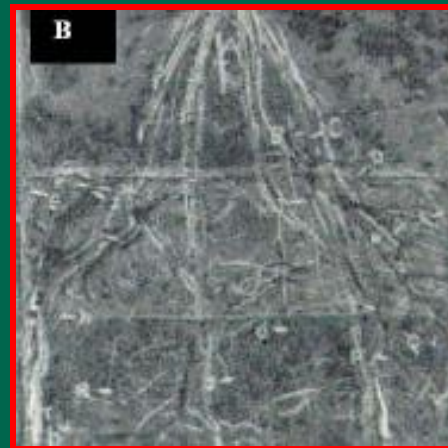
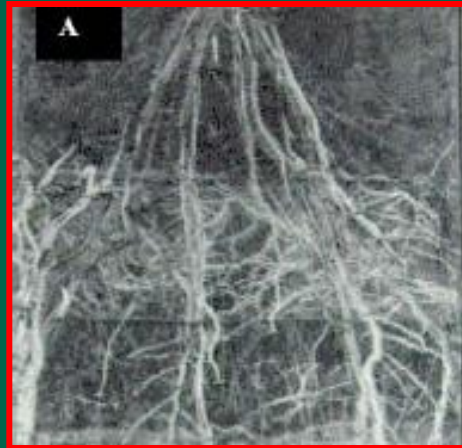


Fonte: Vasconcelos, 2005.



Fonte: Rodrigues, J. D.

# RAIZ DA CANA-DE-AÇÚCAR



C

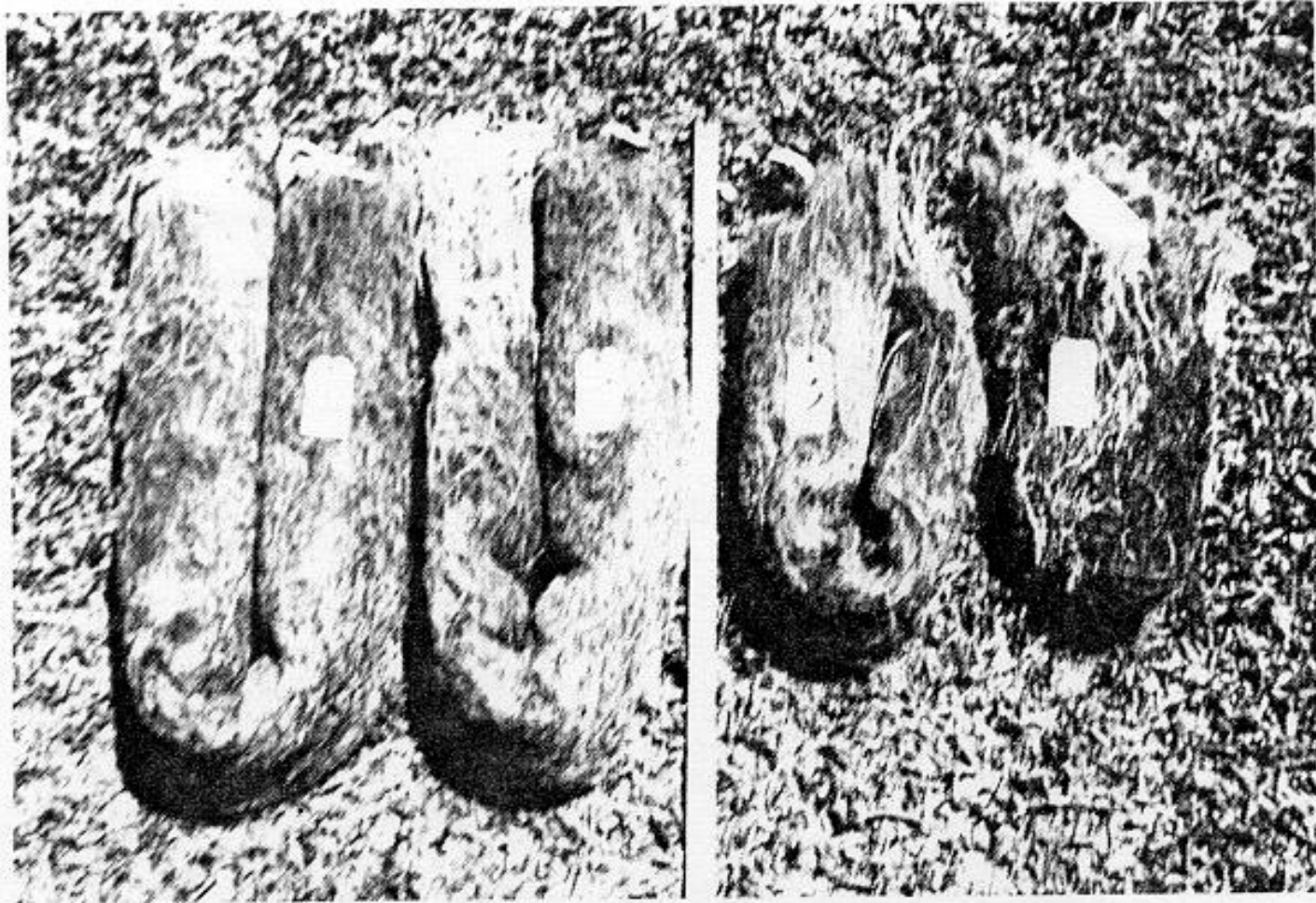
2  
DAC



32  
DAC

60  
DAC

# AERAÇÃO DO SISTEMA RADICULAR





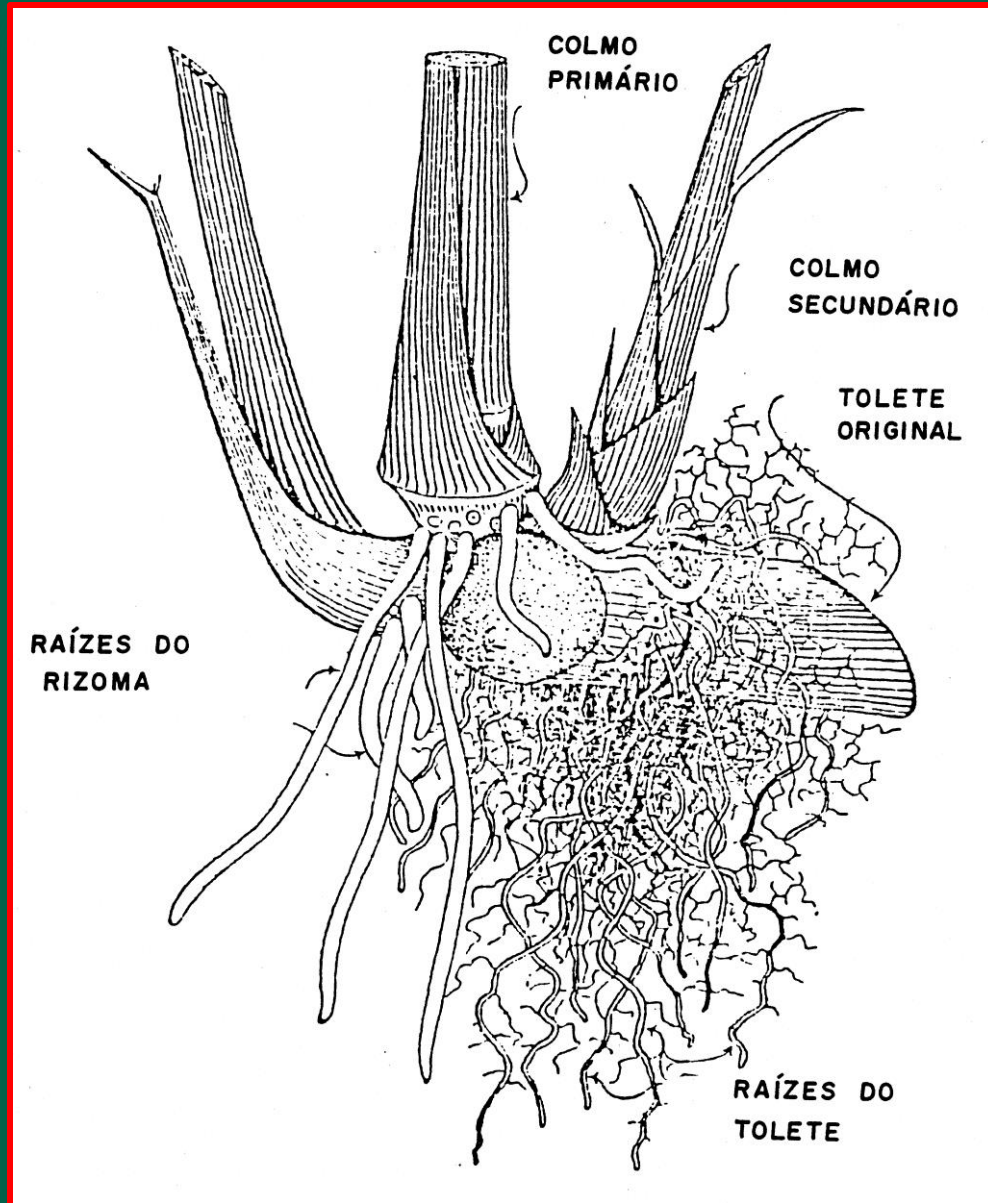
# EFEITO DA PROFUNDIDADE E DO ÂNGULO DE PLANTIO NA PORCENTAGEM DE EMERGÊNCIA

| Days after planting | Planting depth (inches) |    |    |    |     |
|---------------------|-------------------------|----|----|----|-----|
|                     | 1                       | 2  | 3  | 4  | 5   |
| 8                   | 20                      | 10 | -  | -  | -   |
| 9                   | 50                      | 20 | -  | -  | -   |
| 10                  | 50                      | 20 | 10 | -  | -   |
| 11                  | 50                      | 40 | 30 | -  | -   |
| 12                  | 60                      | 60 | 50 | 10 | 30  |
| 13                  | 100                     | 70 | 50 | 10 | 30  |
| 15                  | 100                     | 80 | 60 | 60 | 70  |
| 17                  | 100                     | 80 | 70 | 70 | 90  |
| 19                  | 100                     | 80 | 70 | 80 | 100 |

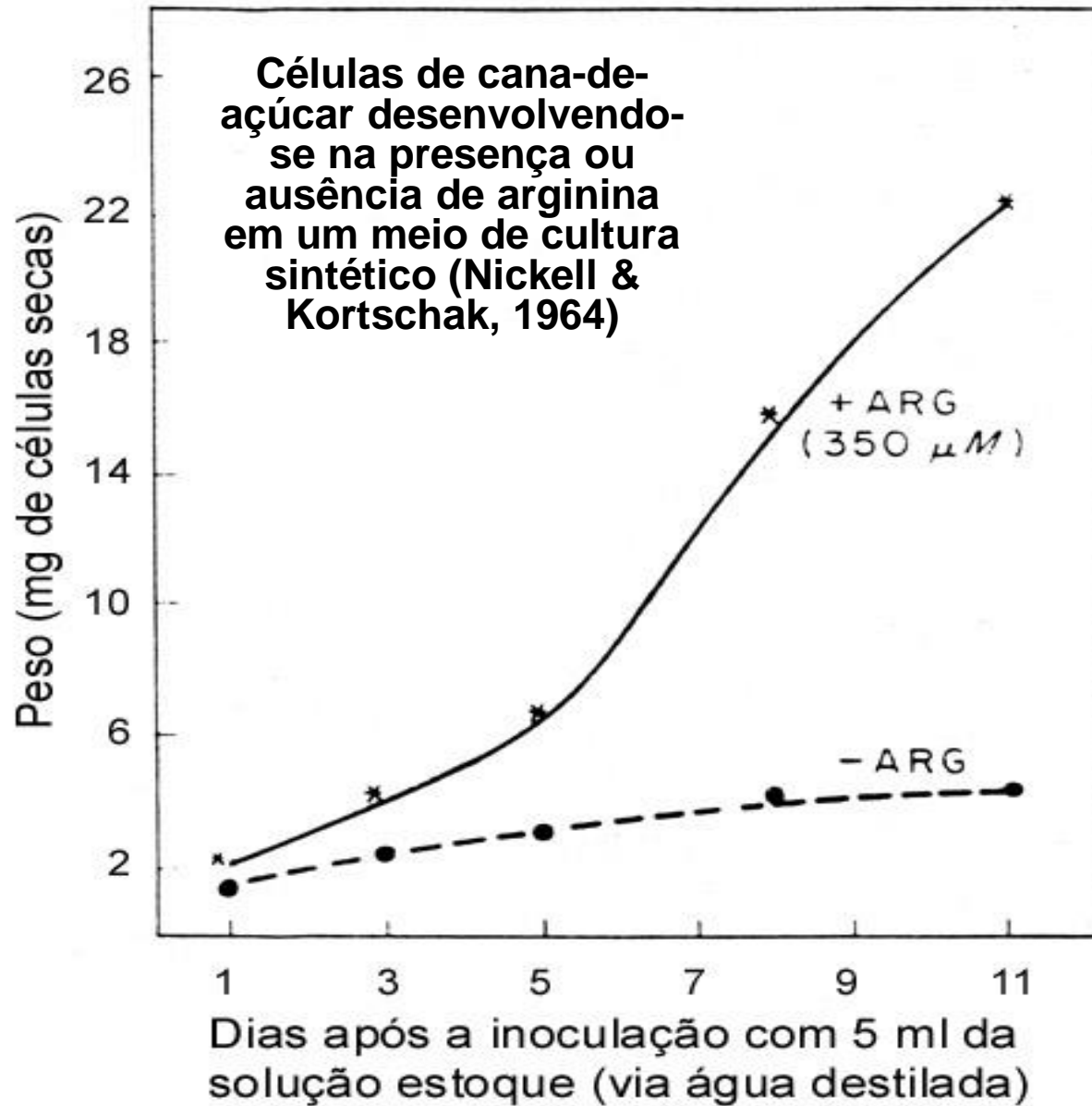
| Days after planting | Planting angle (degree) |     |     |     |     |
|---------------------|-------------------------|-----|-----|-----|-----|
|                     | 1                       | 2   | 3   | 4   | 5   |
| 13                  | 40                      | 30  | -   | -   | -   |
| 14                  | 50                      | 40  | -   | -   | -   |
| 15                  | 60                      | 40  | 10  | -   | -   |
| 17                  | 70                      | 80  | 10  | -   | 10  |
| 19                  | 80                      | 80  | 50  | -   | 20  |
| 20                  | 100                     | 80  | 100 | 30  | 30  |
| 22                  | 100                     | 100 | 100 | 70  | 60  |
| 25                  | 100                     | 100 | 100 | 100 | 100 |



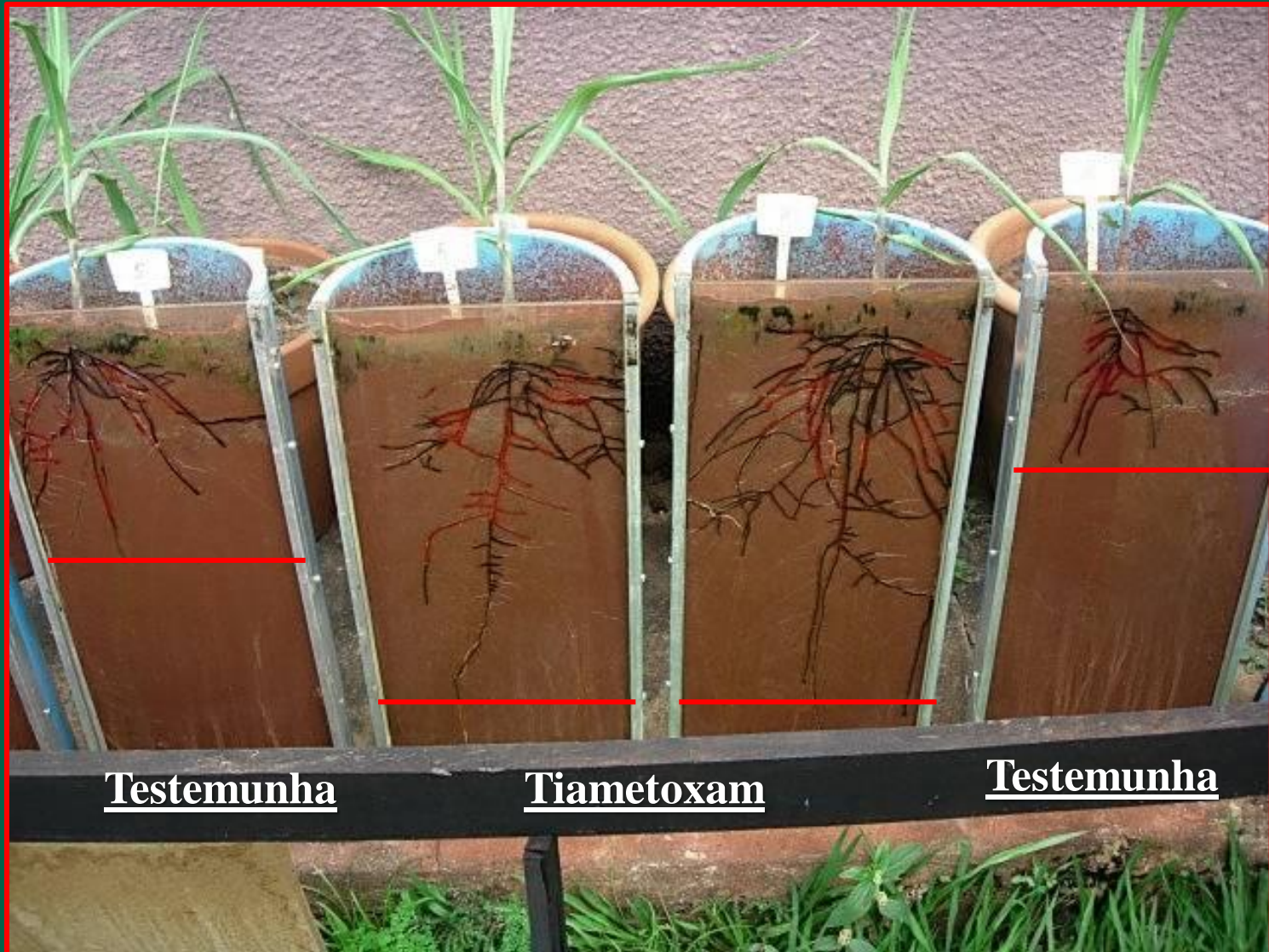
# TOUCEIRA



# ARGININA



# EFEITO DO TIAMETOXAM NO DESENVOLVIMENTO RADICULAR





# PRODUTIVIDADE

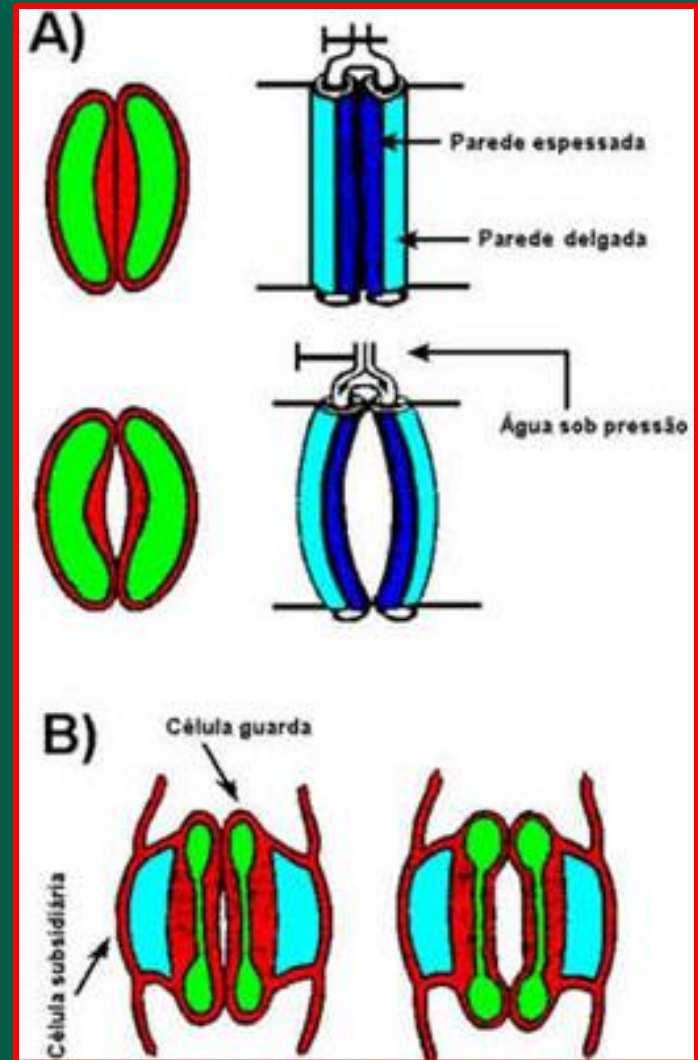
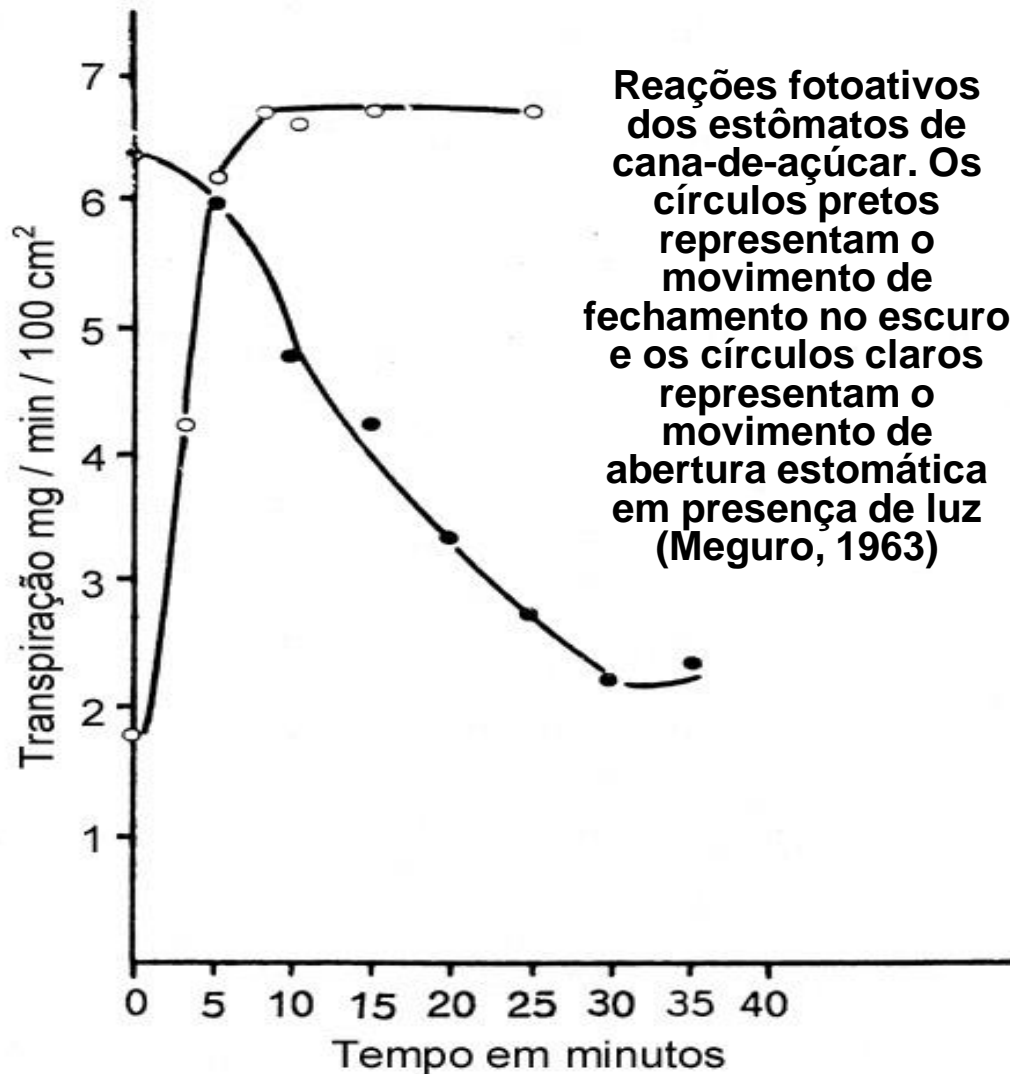




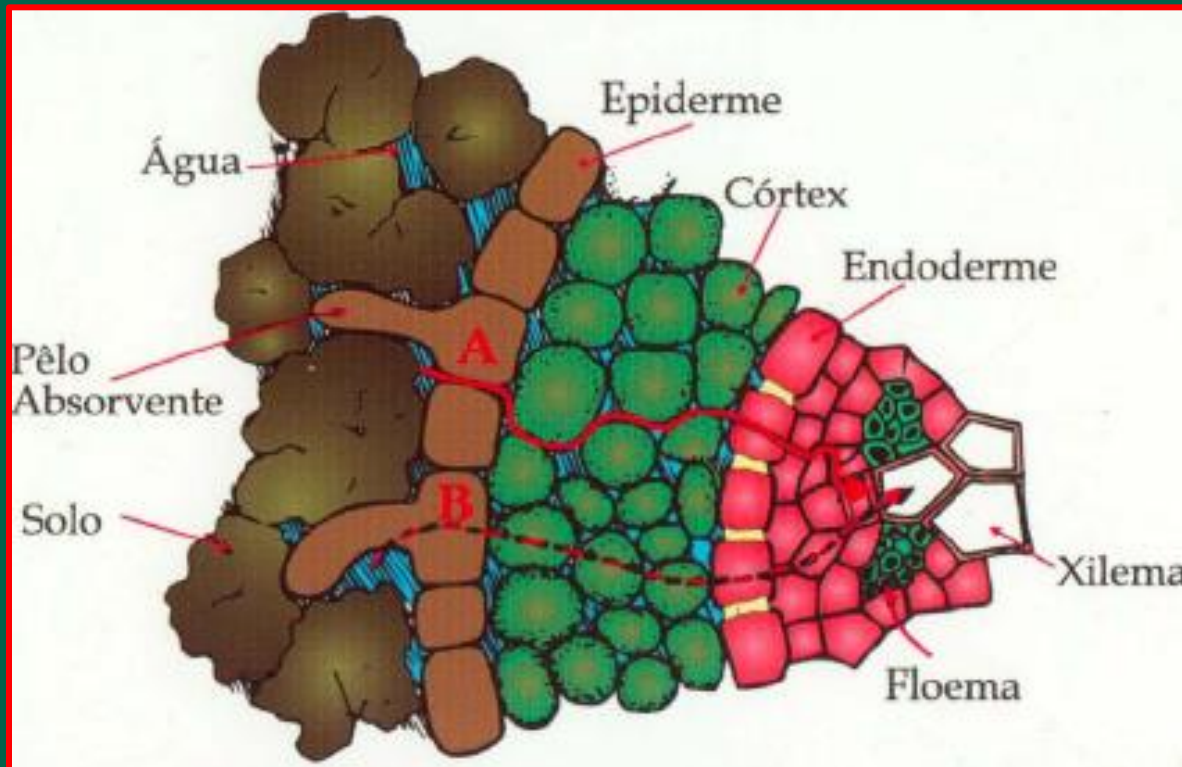
# PRODUTIVIDADE



# REAÇÕES FOTOATIVAS DOS ESTÔMATOS



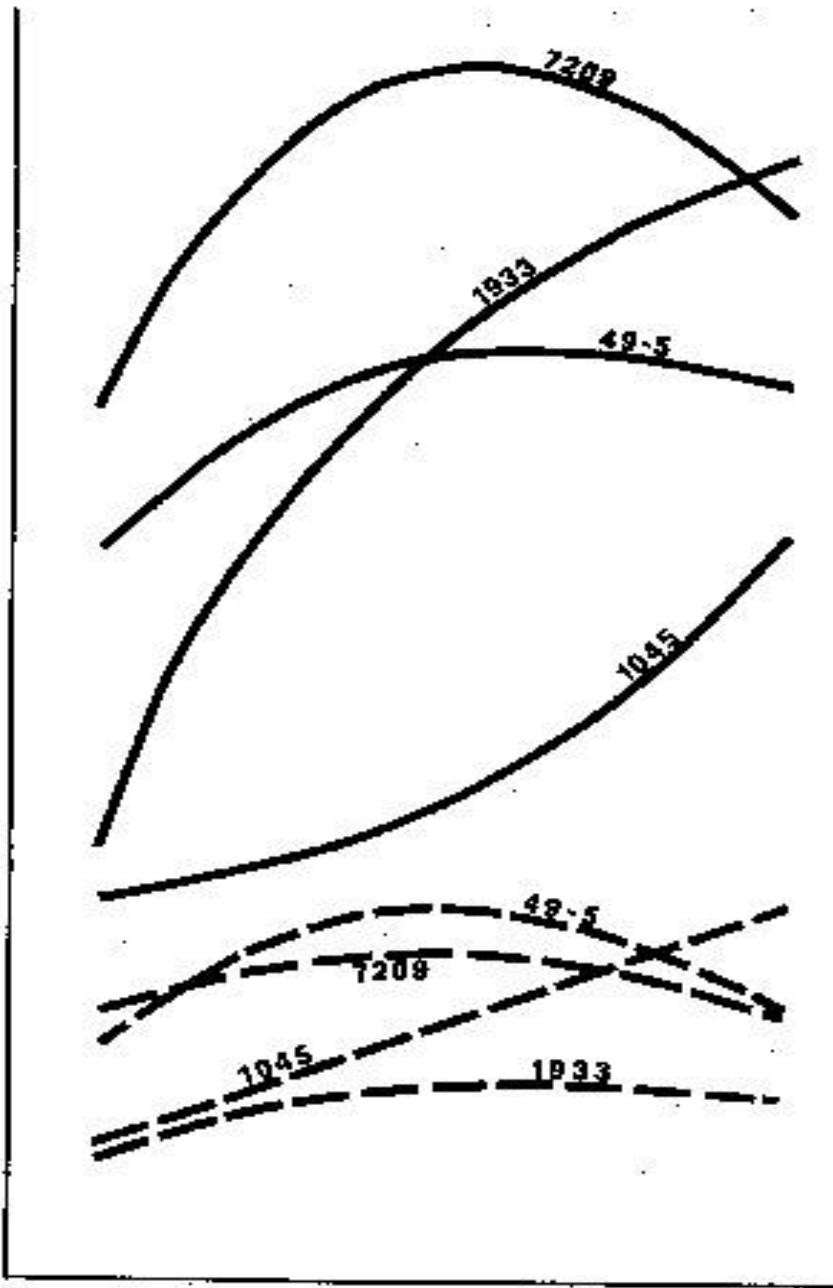
# ABSORÇÃO DE MINERAIS





# NITROGÊNIO

Resposta de cultivares de cana-de-açúcar ao aumento de nitrogênio (eixo horizontal) medida em termos de produção total de cana (eixo vertical). As quatro curvas superiores correspondem a insolação total, as 4 inferiores resultam de 50% de sombreamento.





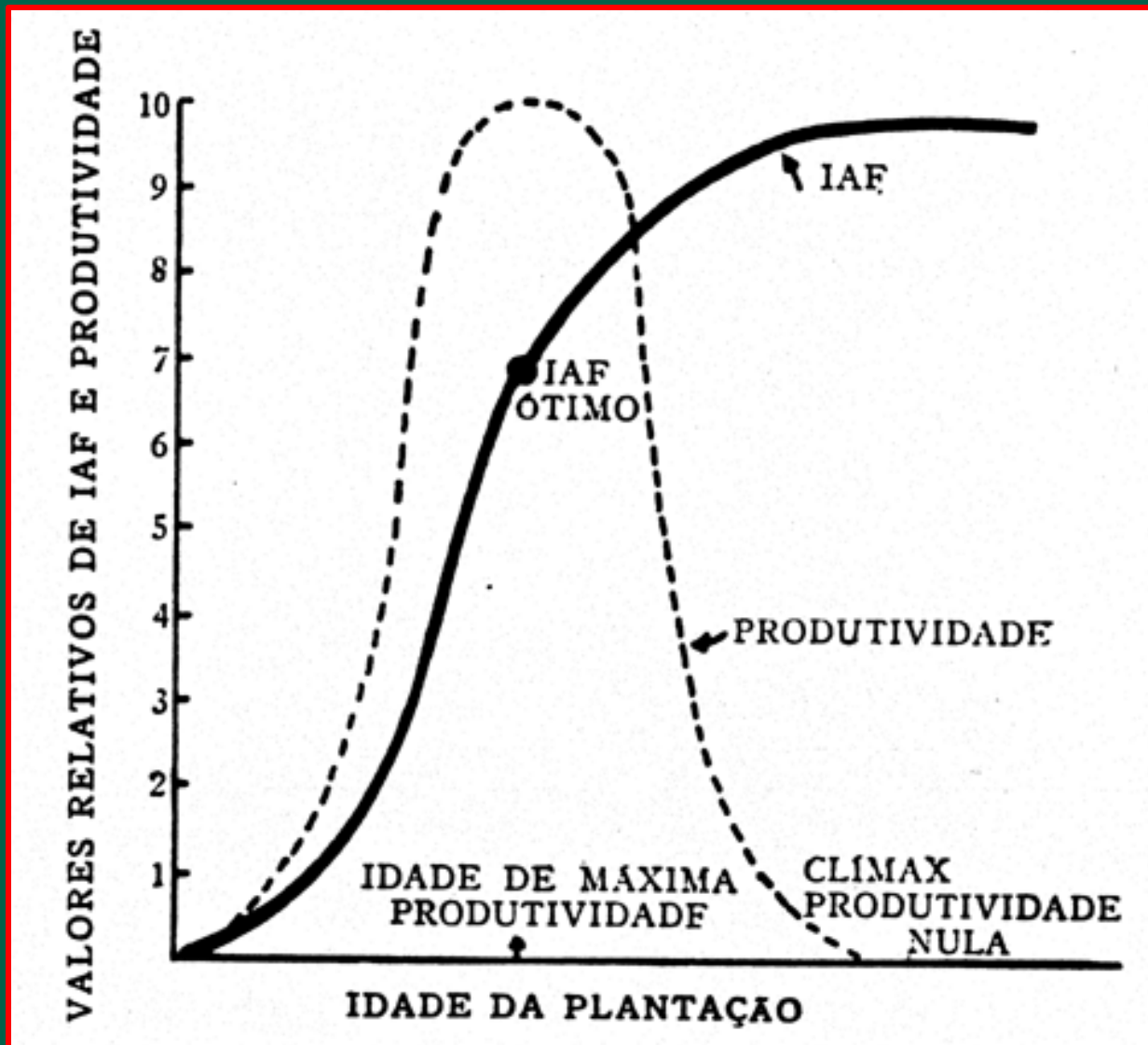
# NÍVEIS ADEQUADOS DE NUTRIENTES NO TECIDO FOLIAR DA CANA-DE-AÇÚCAR

| Nutrientes | Teor (ppm) |             | Tecido foliar utilizado | Idade do tecido (meses) | Correção kg/ha |
|------------|------------|-------------|-------------------------|-------------------------|----------------|
|            | Crítico    | Ótimo       |                         |                         |                |
| N          | -          | 1,65-2,59   | 3                       | 04-9                    | 20-100         |
| P          | 0,15       | 0,20-0,35   | 3                       | 04-9                    | 0-80           |
| K          | 0,62       | 0,62-1,45   | 3                       | 6                       | 99             |
| Al*        |            |             |                         |                         |                |
| B          | 1          | 6-29        | 3                       | 4-16                    | 3-4,5          |
| Ca         | -          | 0,43-0,76** | 3                       | 4-9                     | -              |
| Cl*        |            |             |                         |                         |                |
| Cu         | -          | 9-17        | 3                       | 4-9                     | 6              |
| S**        | -          | 0,13-0,28   | 3                       | 6                       | 50             |
| Fe         | -          | 76-392      | 3                       | 4-9                     | 6-10           |
| Mg         | -          | 0,11-0,36   | 3                       | 4-9                     | -              |
| Mn         | -          | 73-249      | 3                       | 4-9                     | 3-6            |
| Mo*        |            |             |                         |                         |                |
| Si*        |            |             |                         |                         |                |
| Na*        |            |             |                         |                         |                |
| Zn*        |            |             |                         |                         |                |

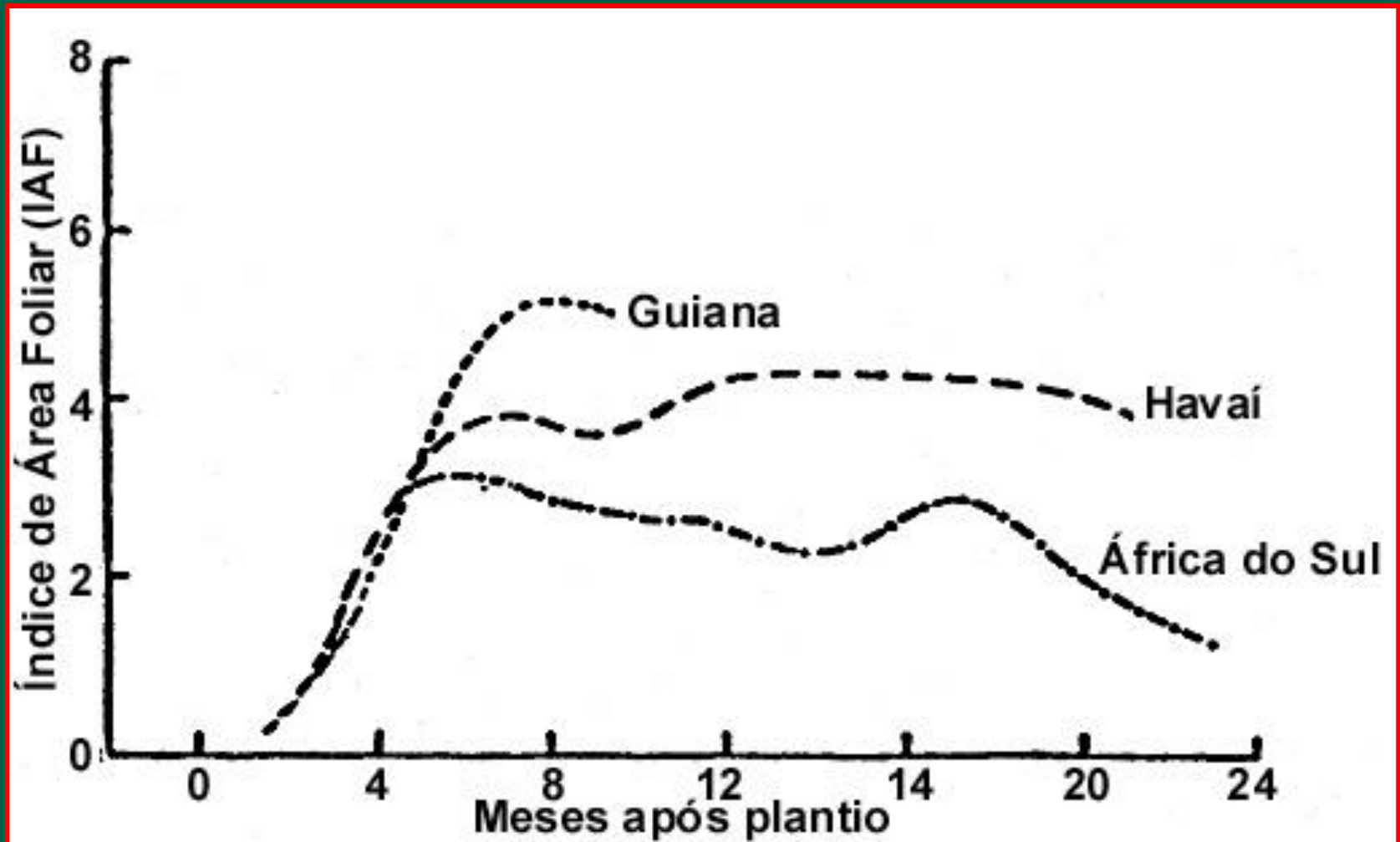
Dados não publicados \*\* variação calculada com base na massa seca

Fonte: Baseado nos dados fornecidos por Anderson & Bowen (1992)

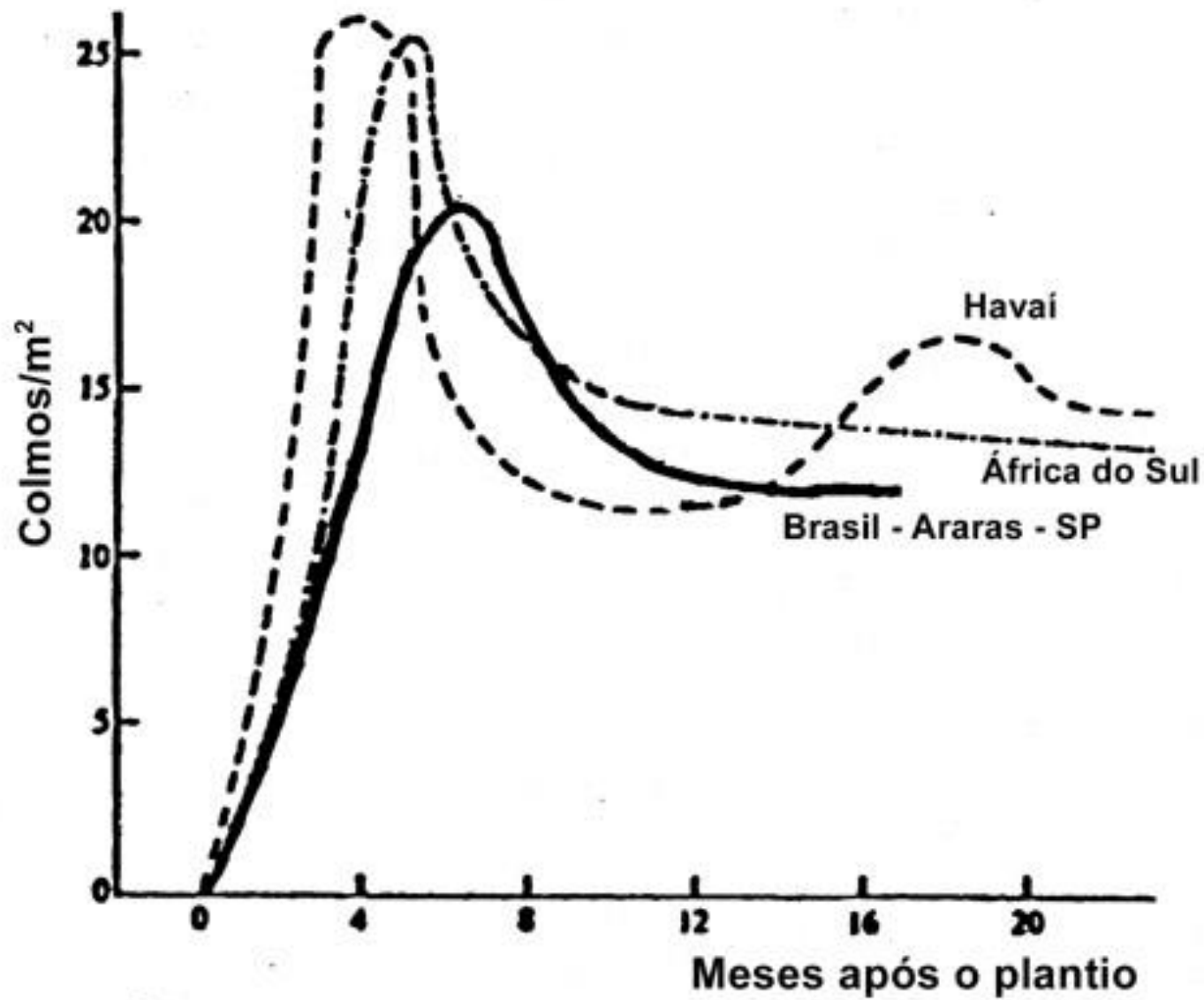
# ÍNDICE DE ÁREA FOLIAR (IAF) E PRODUTIVIDADE



# DIFERENÇAS NO ÍNDICE DE ÁREA FOLIAR

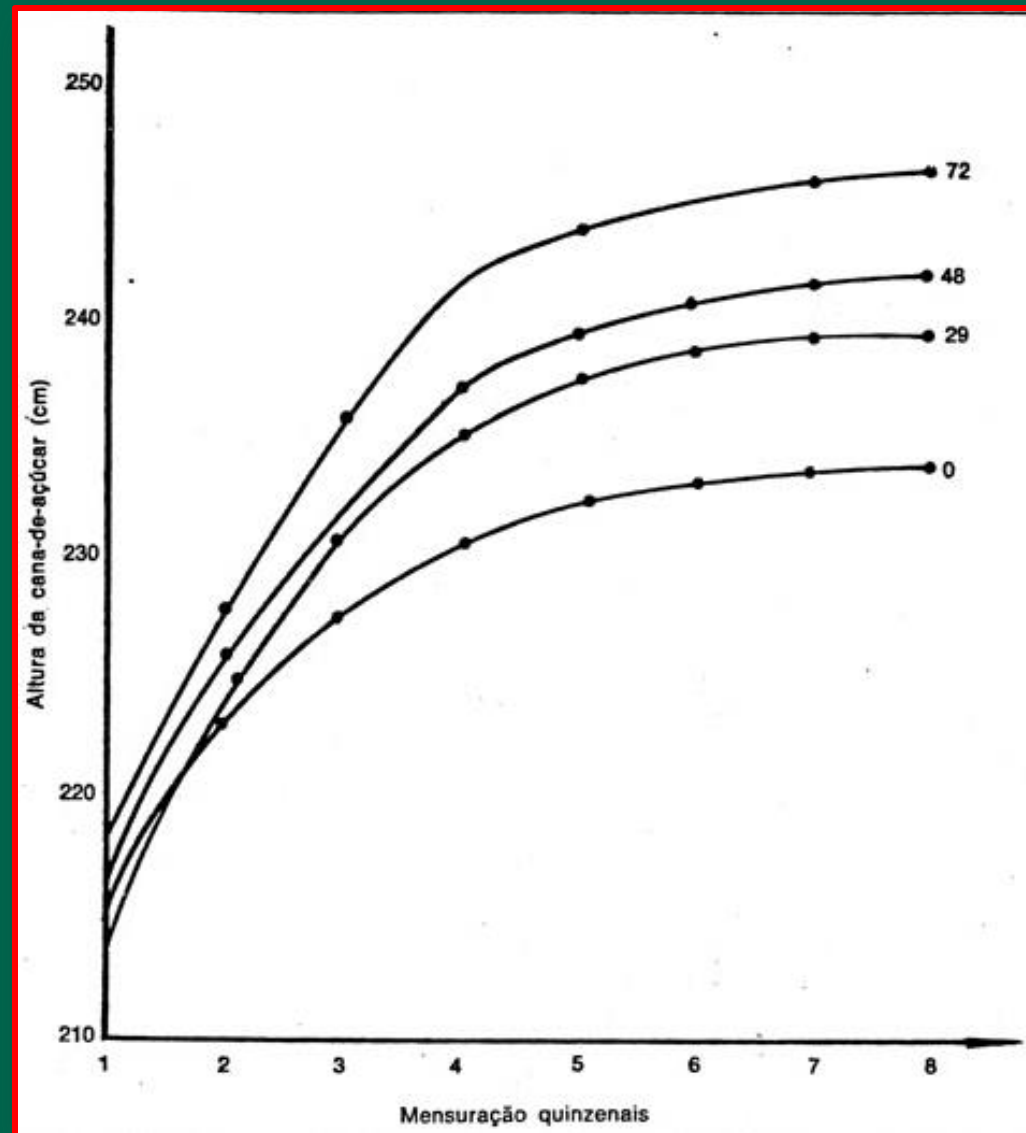


# NÚMERO DE COLMOS





# ÁCIDO GIBERÉLICO – ALTURA DAS PLANTAS (cm)



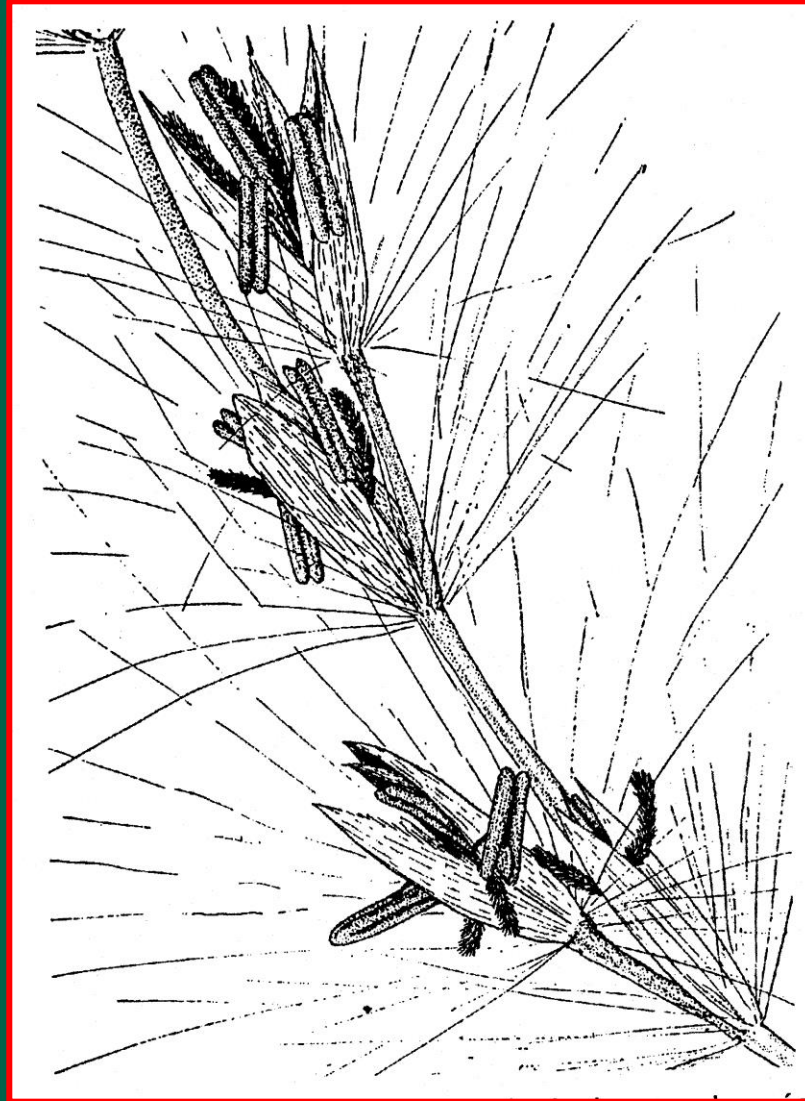
# **CARACTERÍSTICAS MORFOLÓGICAS ASSOCIADAS À PRODUTIVIDADE DA CANA-DE-AÇÚCAR**

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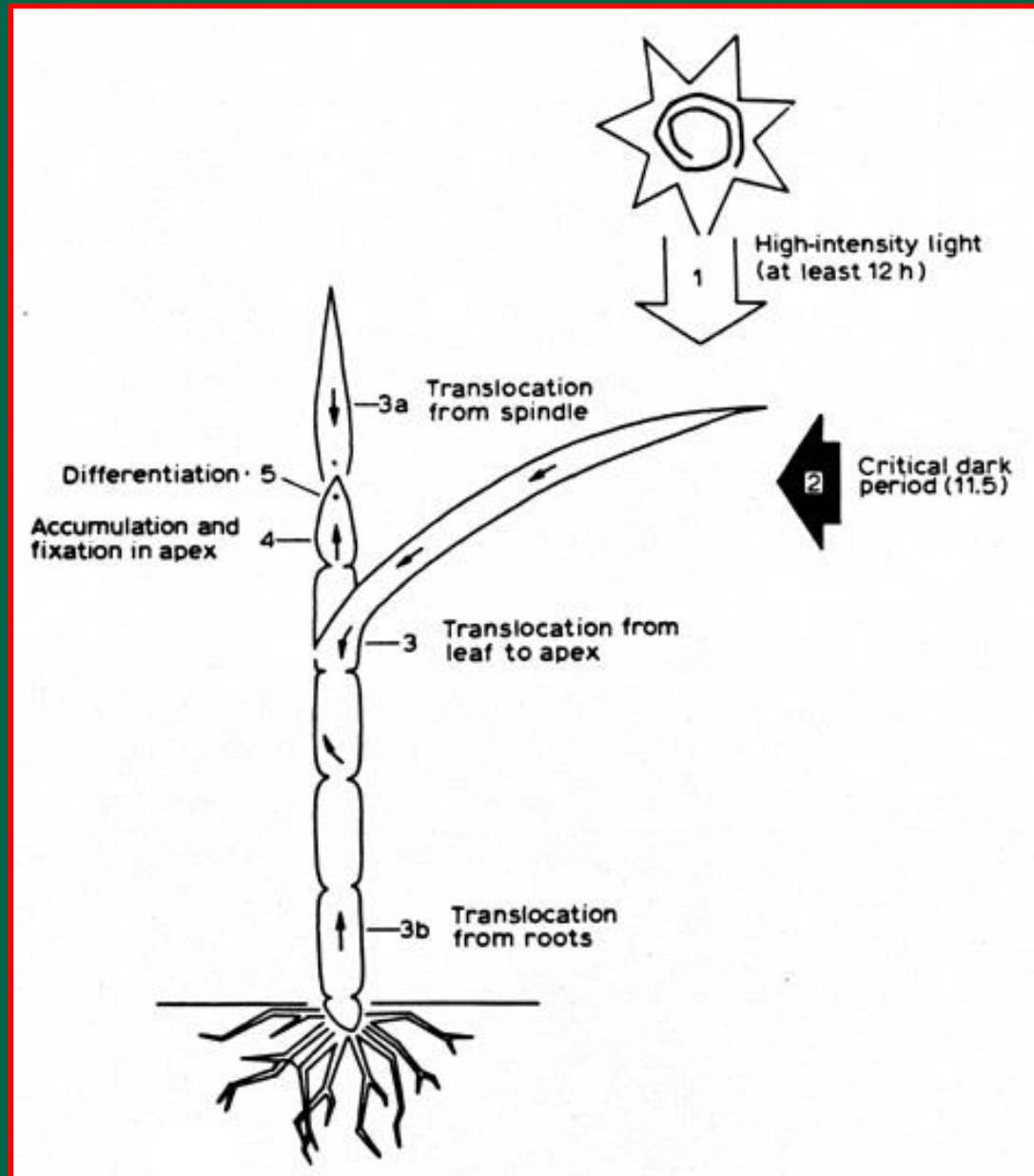
| <b>Parte da planta</b> | <b>Característica desejável</b>                        | <b>Efeito na fotossíntese e na produção</b>  |
|------------------------|--|--|
| <b>Perfilhos</b>       | <b>Vertical<br/>Alto perfilhamento</b>                 | <b>Melhor penetração da luz<br/>Substituição de plantas mortas<br/>Desenvolvimento rápido do IAF</b>             |
| <b>Folha</b>           | <b>Espessa<br/>Curta e pequena<br/>Ereta</b>           | <b>Hábito mais ereto<br/>Associada a hábito mais ereto<br/>Aumento na área iluminada<br/>permite IAF maiores</b> |
| <b>Colmos</b>          | <b>Alta força de dreno<br/>para sacarose<br/>Firme</b> | <b>Alta produtividade<br/><br/>Previne acabamentoo</b>   |

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# INFLORESCÊNCIA

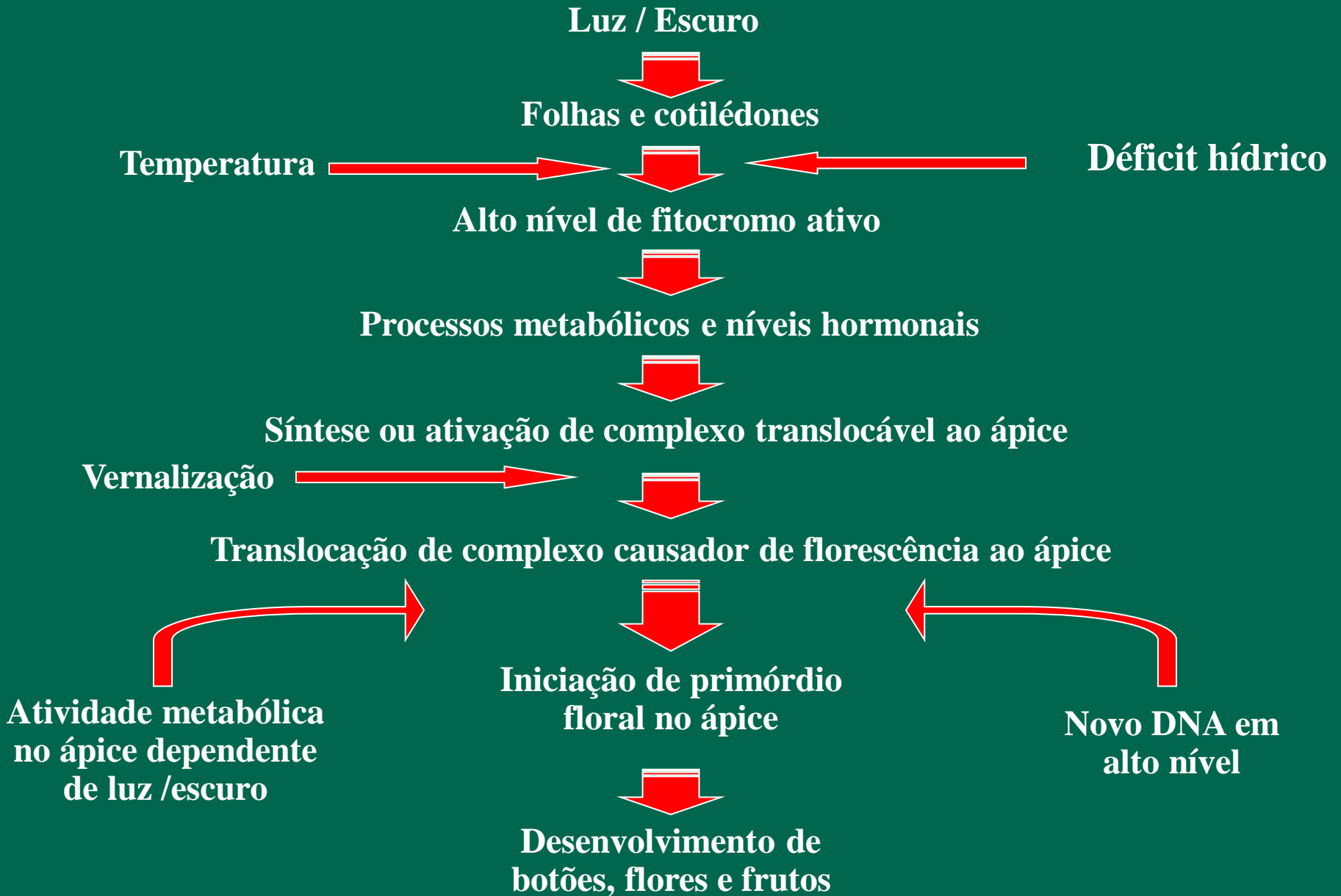


# PROCESSO DO FLORESCIMENTO





# EVENTOS QUE LEVAM AO FLORESCIMENTO



# EFICIÊNCIA FOTOSSINTÉTICA



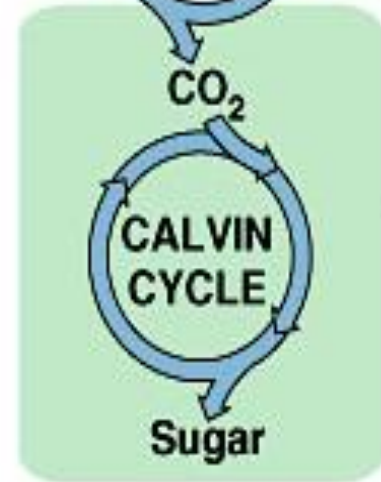
Sugarcane

$C_4$

**Mesophyll cell**



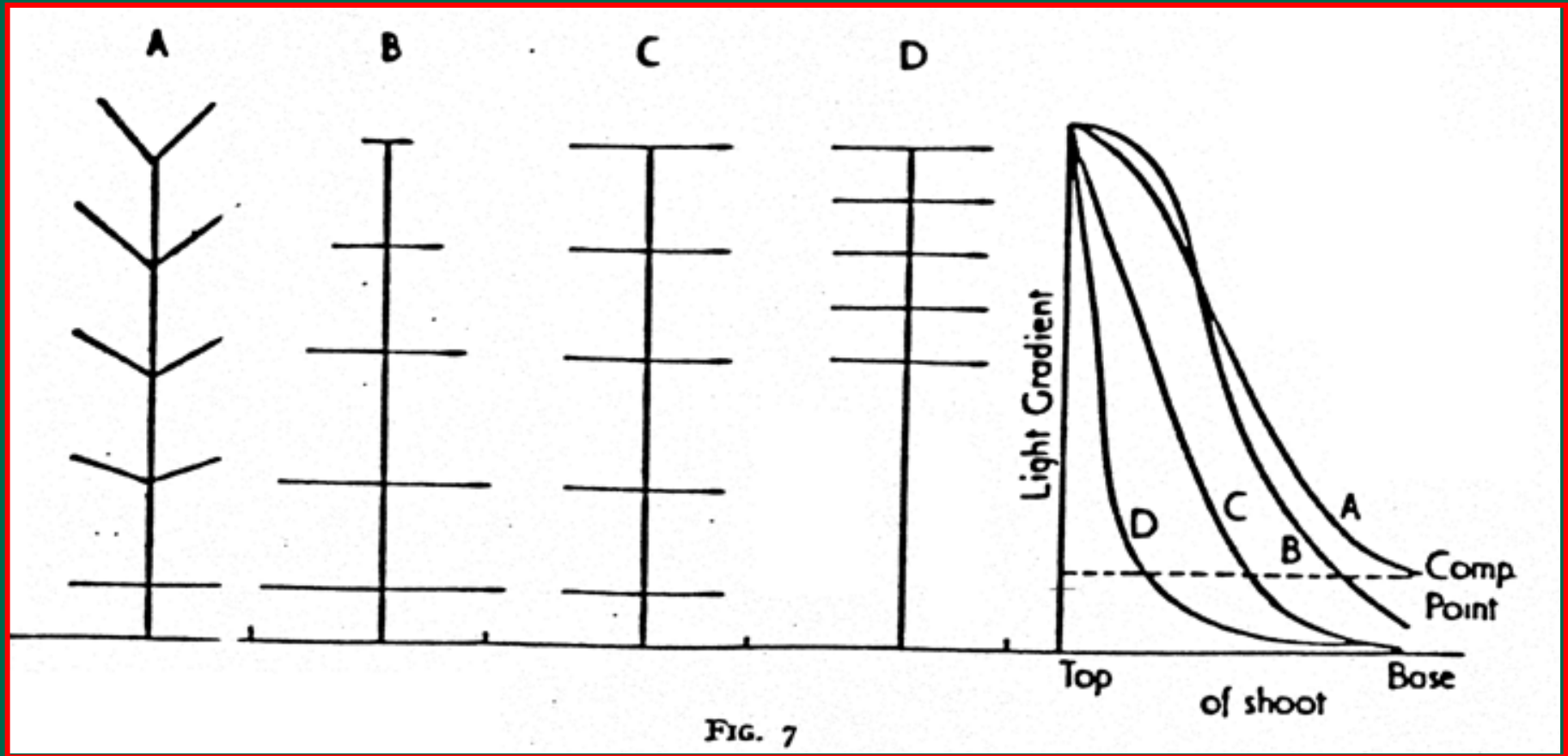
**Bundle-sheath cell**



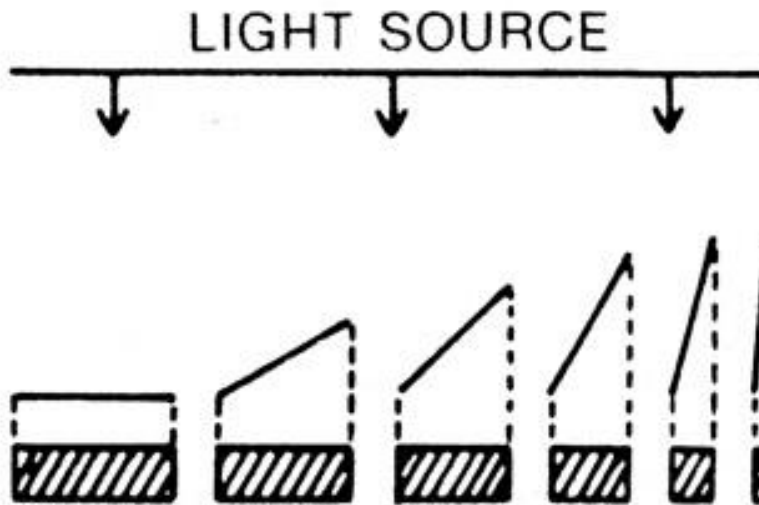
**(a) Spatial separation of steps**

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# ARQUITETURA FOLIAR



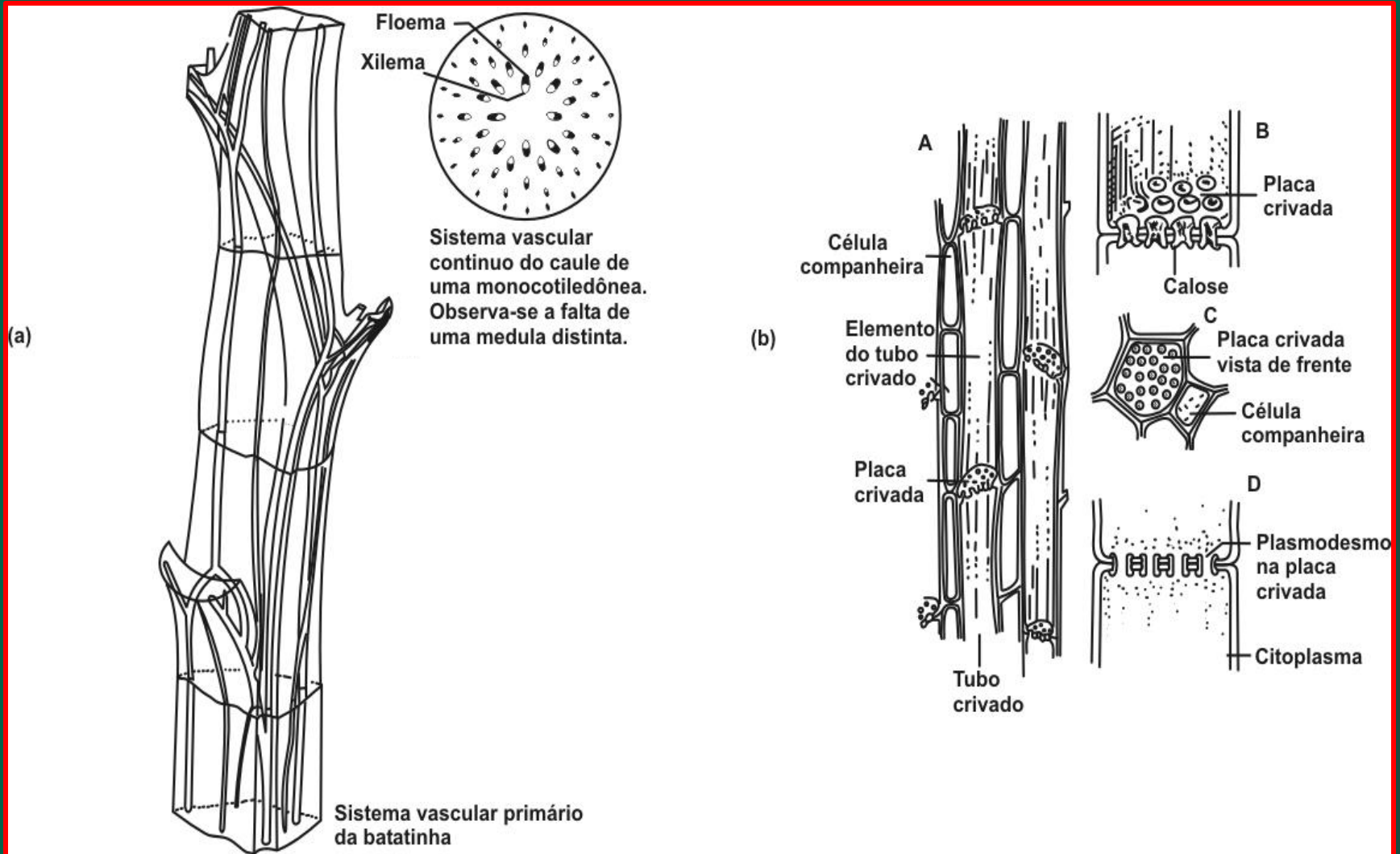
# PENETRAÇÃO DA LUZ



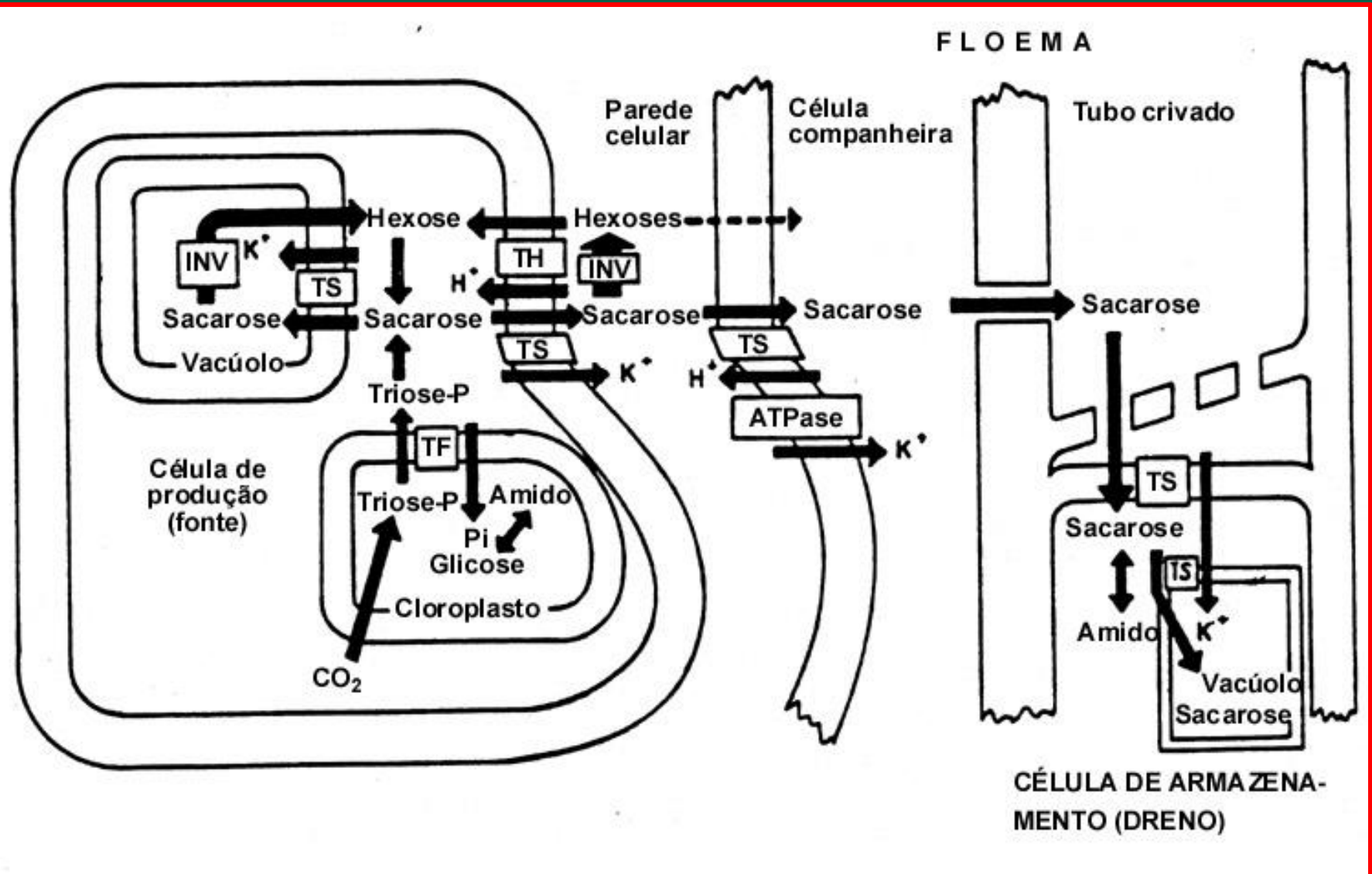
|                           |     |     |     |     |     |     |
|---------------------------|-----|-----|-----|-----|-----|-----|
| DEGREES FROM HORIZONTAL   | 0   | 30  | 45  | 60  | 75  | 85  |
| EFFECTIVE LIGHT INTENSITY | 1   | .87 | .71 | .50 | .26 | .09 |
| LIGHT PENETRATION (%)     | 10  | 22  | 36  | 55  | 77  | 90  |
| AREA SHADED               | 1   | .87 | .71 | .50 | .26 | .09 |
| K-VALUE                   | 2.3 | 1.5 | 1.0 | 0.6 | .26 | .10 |



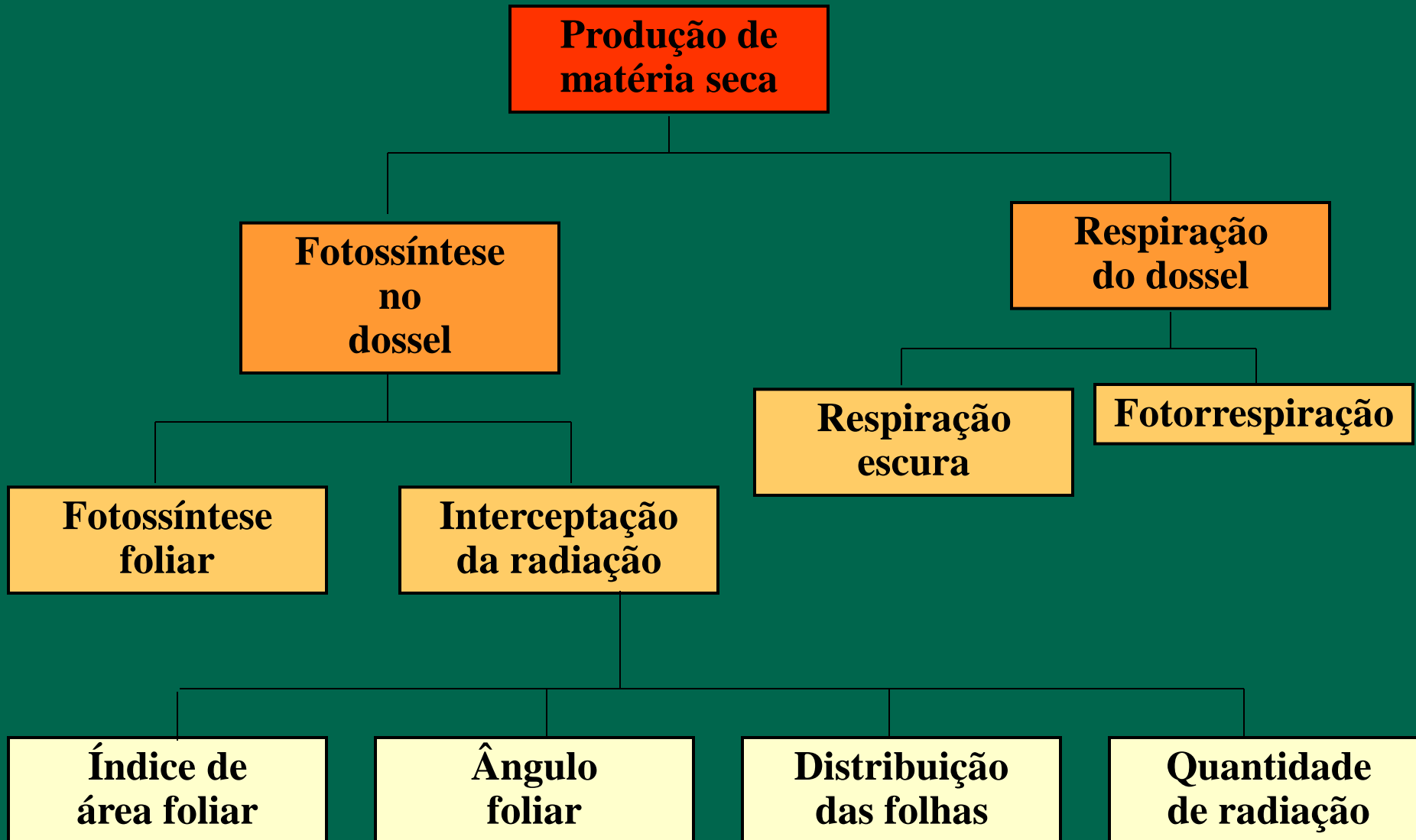
# FLUXO DE PRESSÃO NO FLOEMA



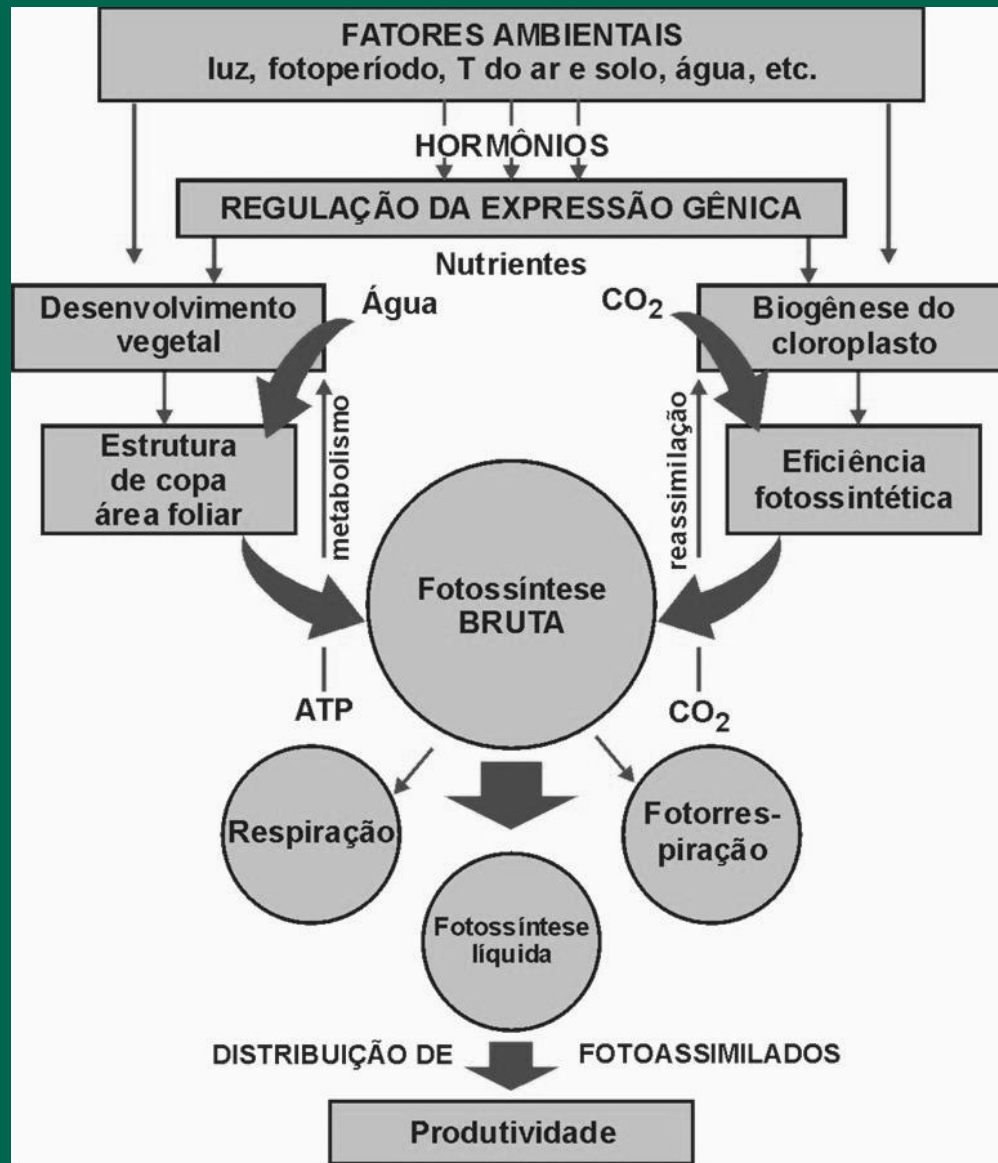
# RELAÇÕES FONTE-DRENO



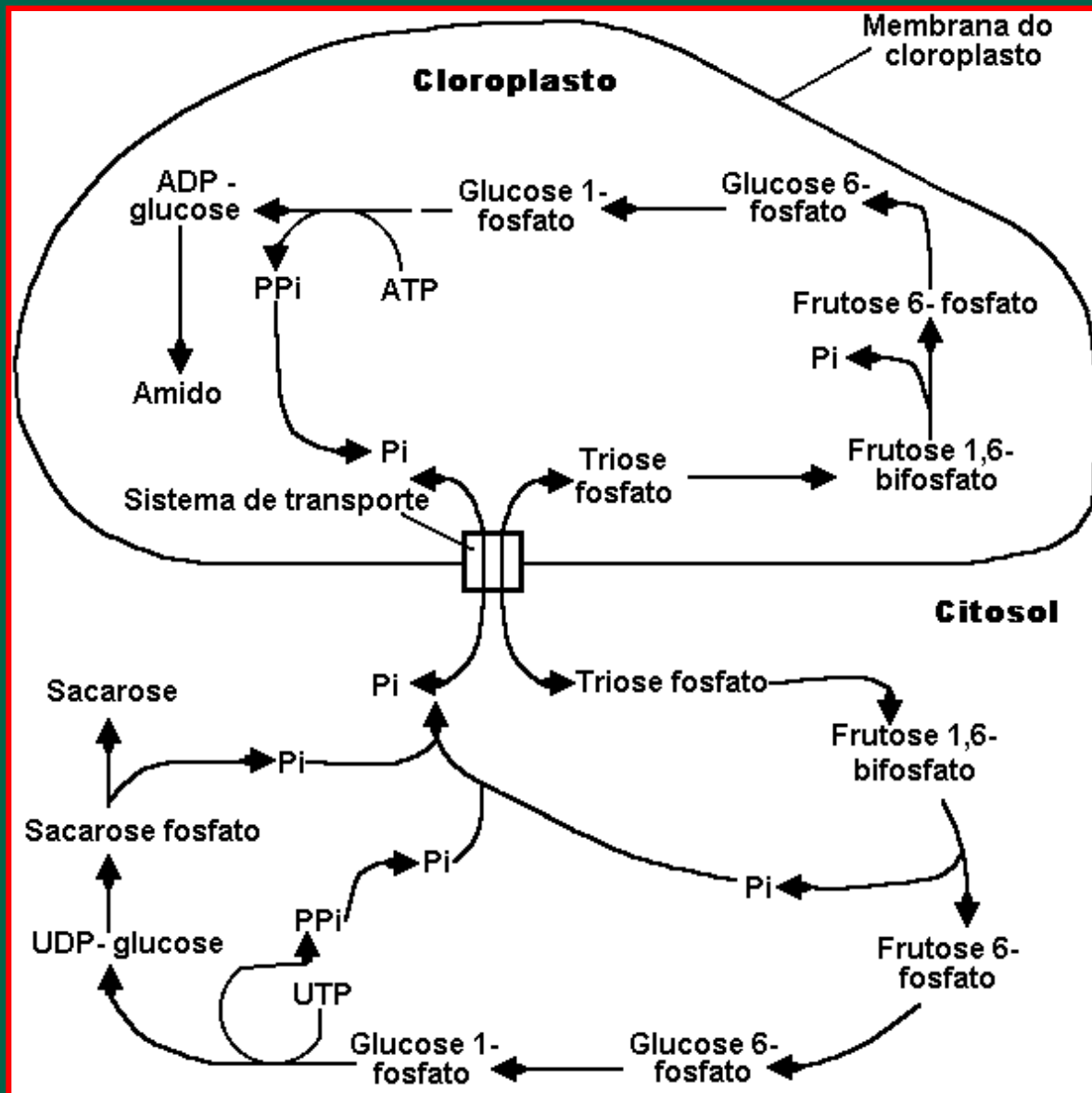
# DEPENDÊNCIA DA PRODUTIVIDADE VEGETAL



# PRODUTIVIDADE

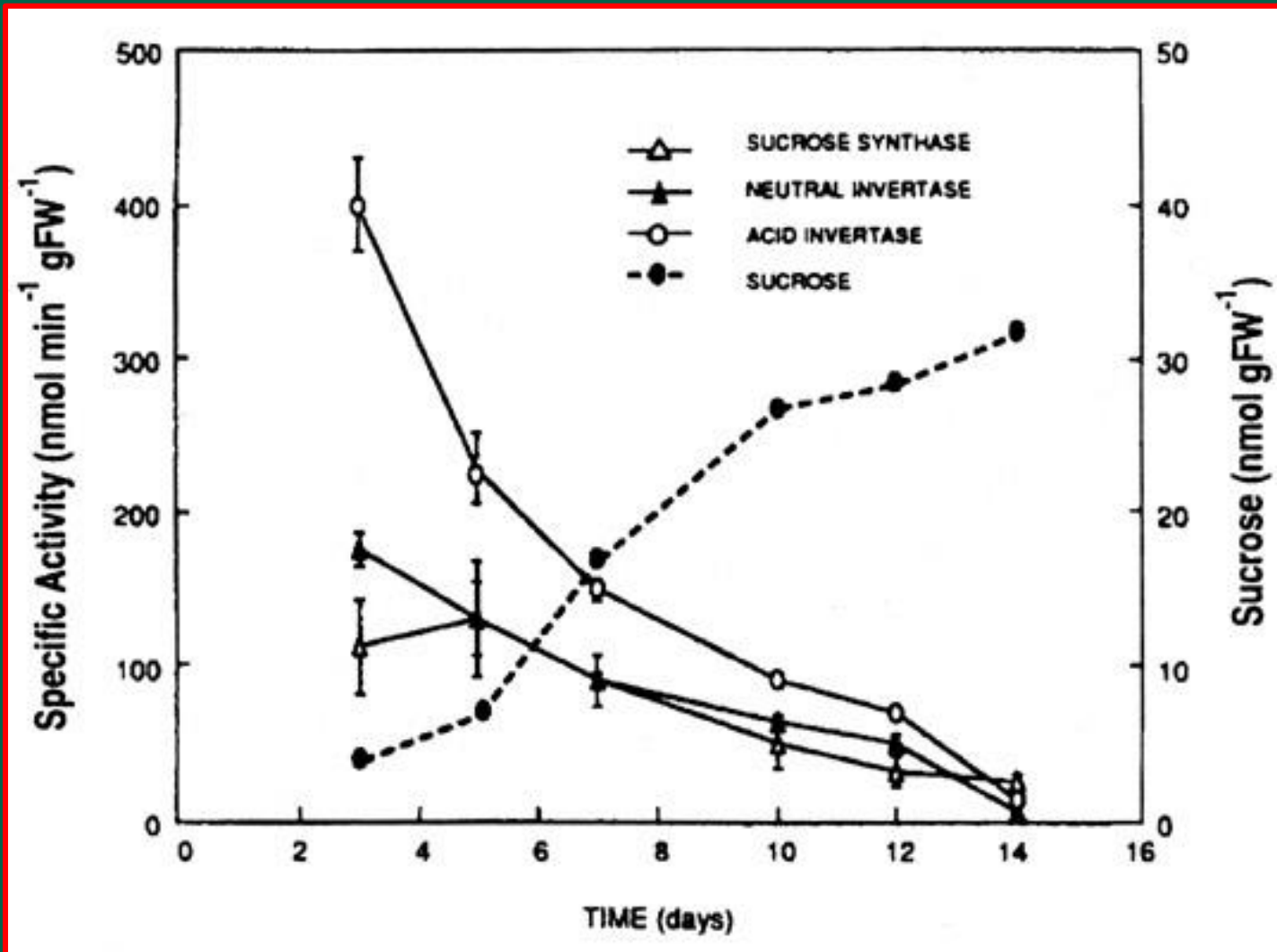


# SÍNTESE DE AMIDO E DE SACAROSE

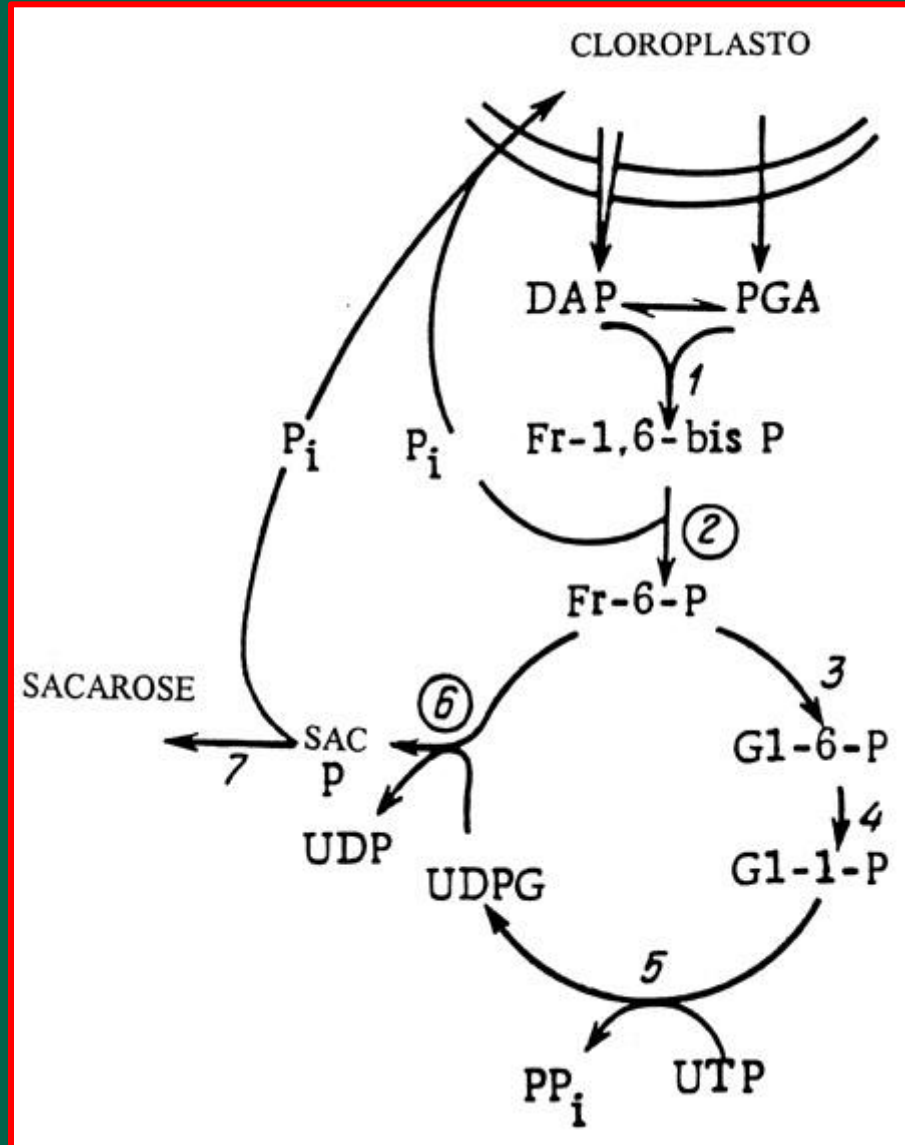


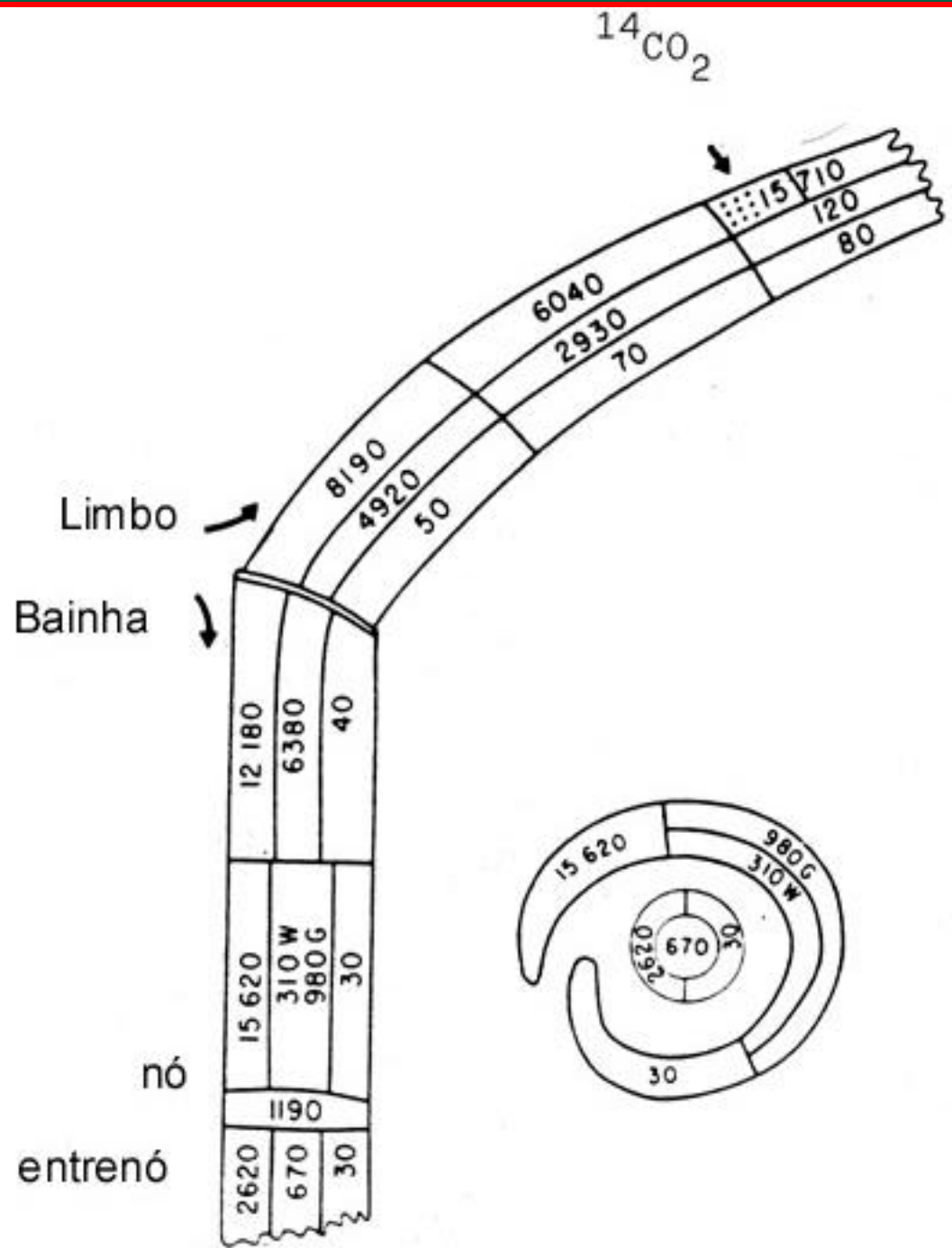


# SACAROSE E ATIVIDADE ESPECÍFICA DE ENZIMAS



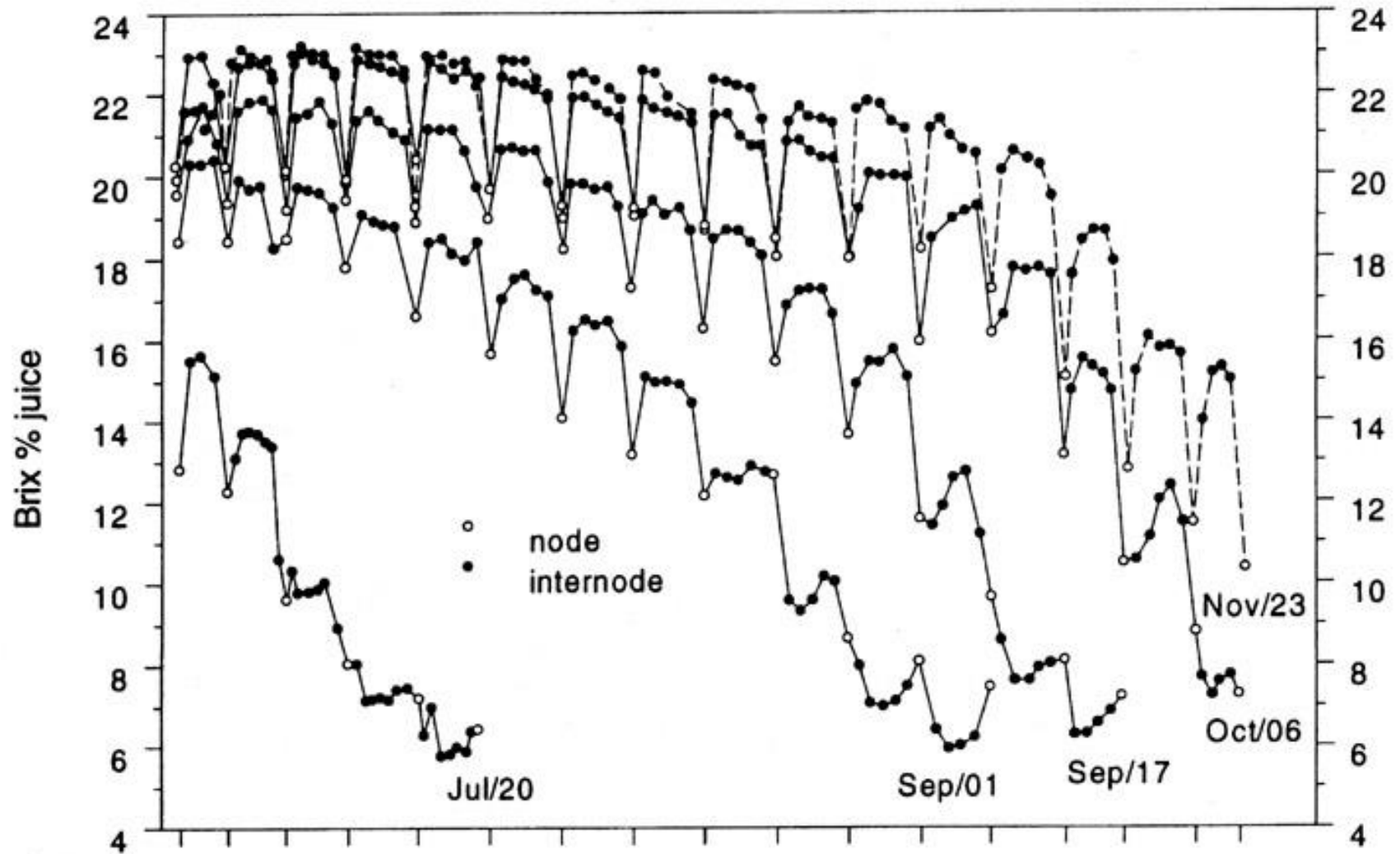
# SÍNTESE DE SACAROSE





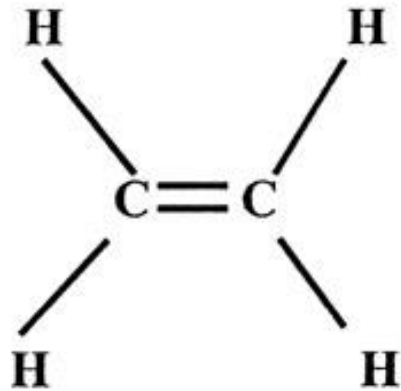
**Via de movimento de fotossintetizados no limbo foliar de cana-de-açúcar e na bainha que envolve o colmo.**

# DISTRIBUIÇÃO DO BRUX

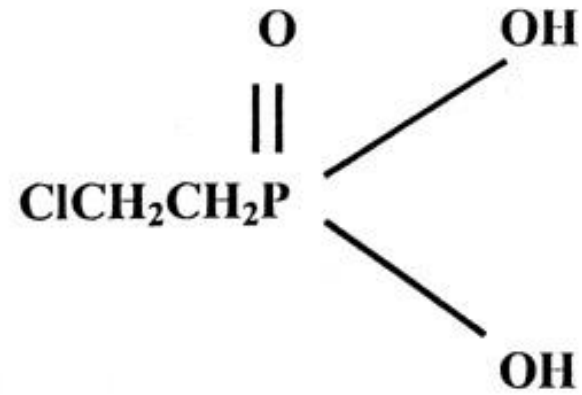




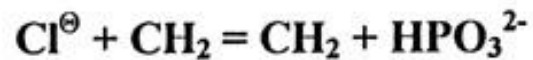
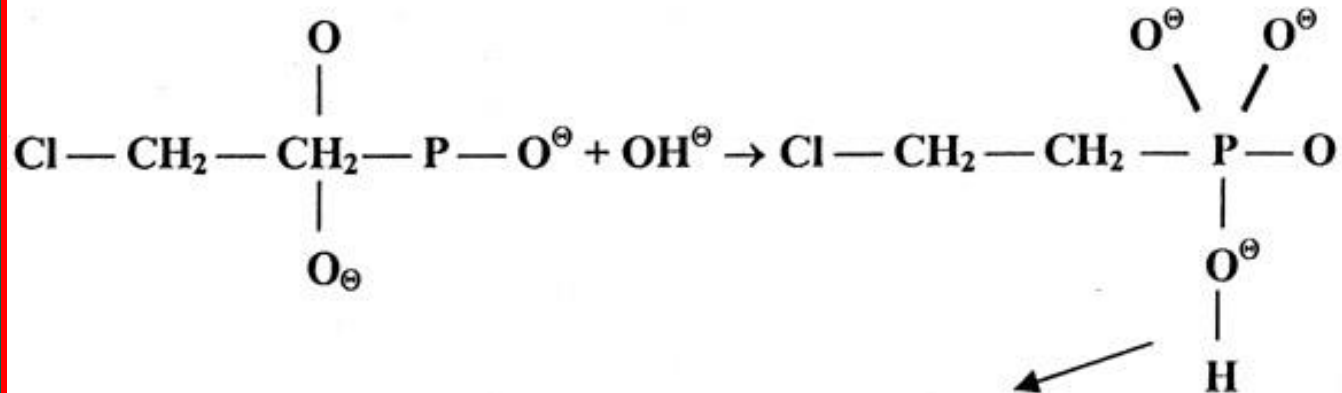
# ETILENO E ETHEPHON



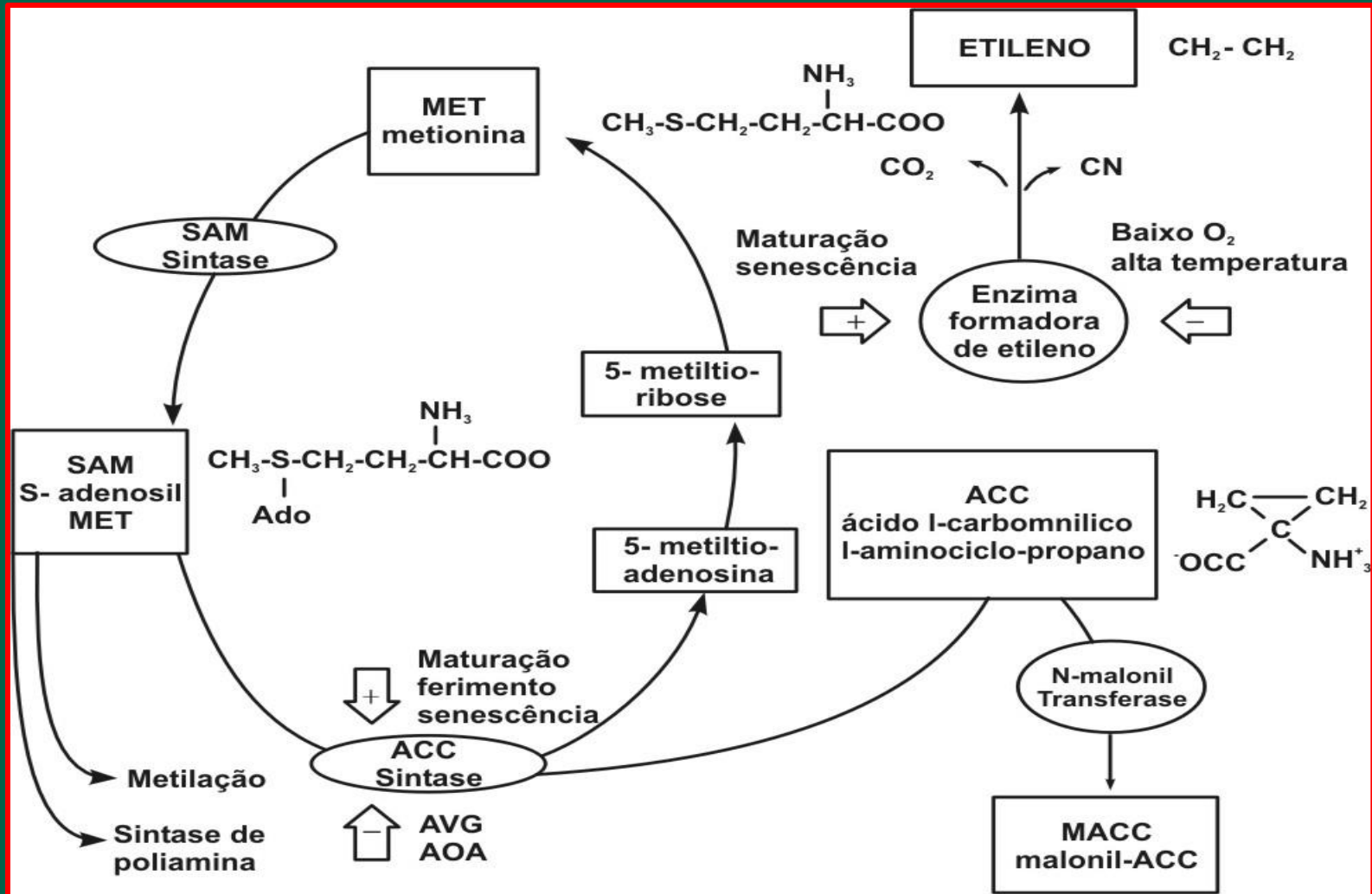
ETILENO



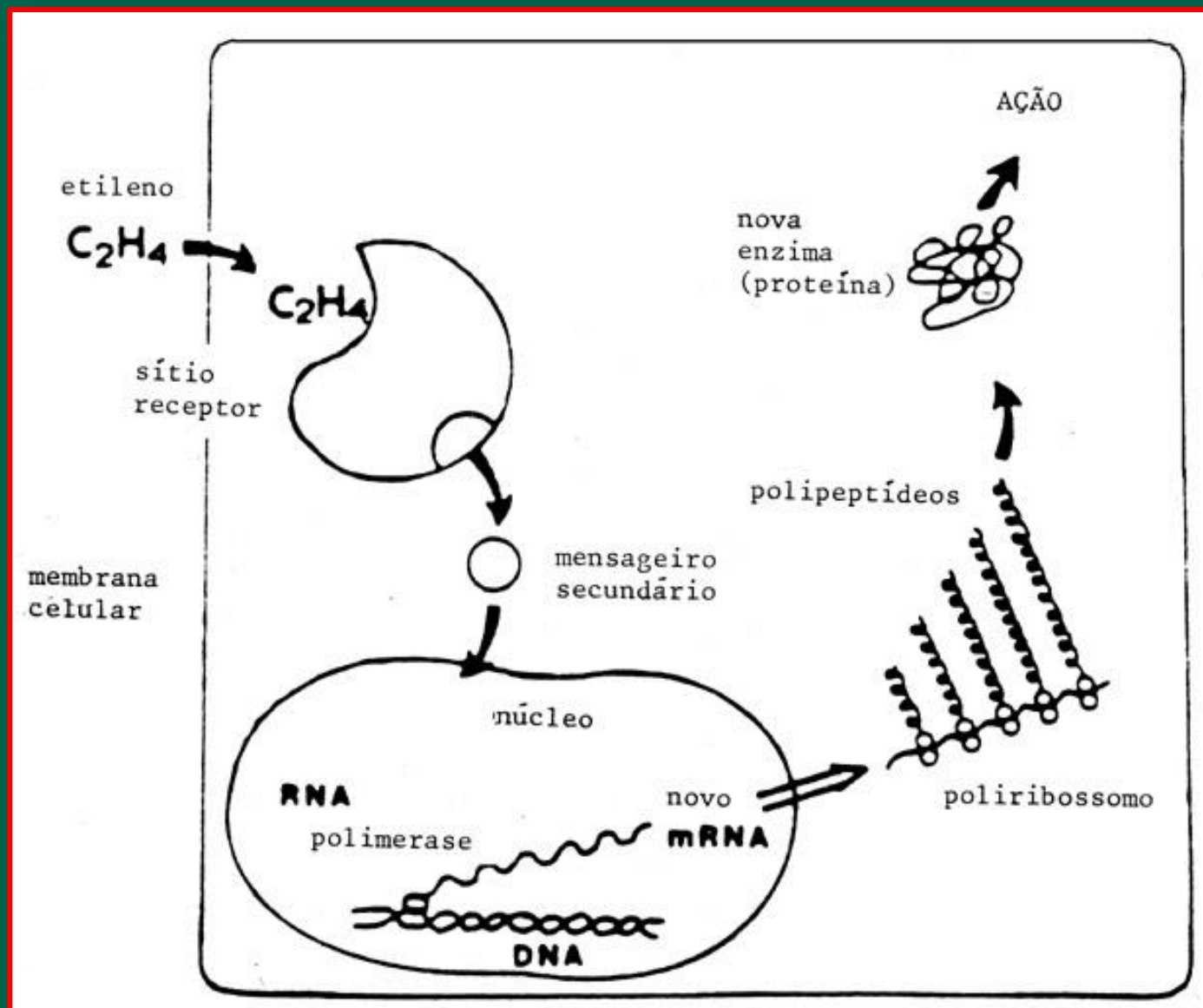
ETHEPHON



# FORMAÇÃO DE ETILENO



# MECANISMO DE AÇÃO DE ETILENO

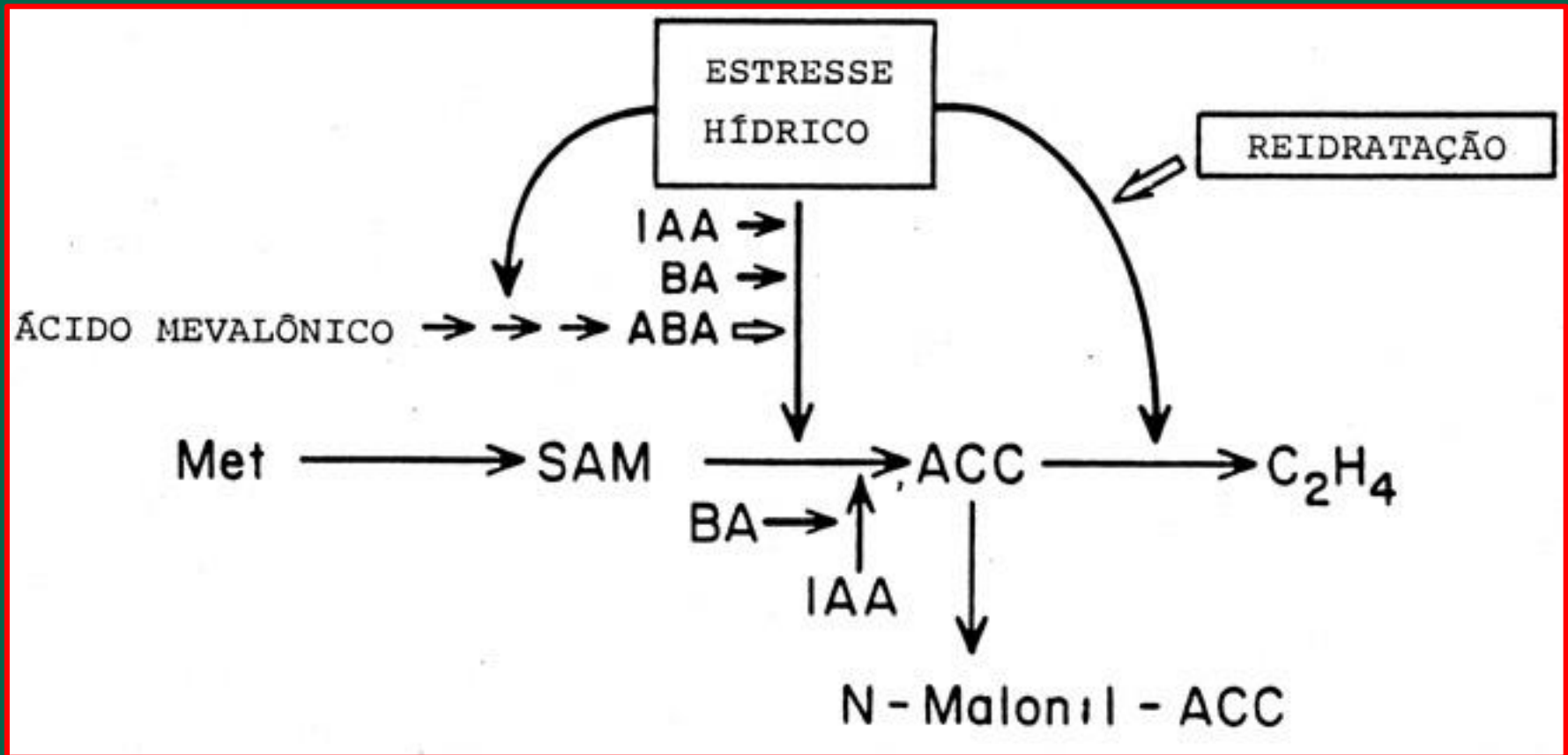


# RESPOSTA AO ETHEPHON

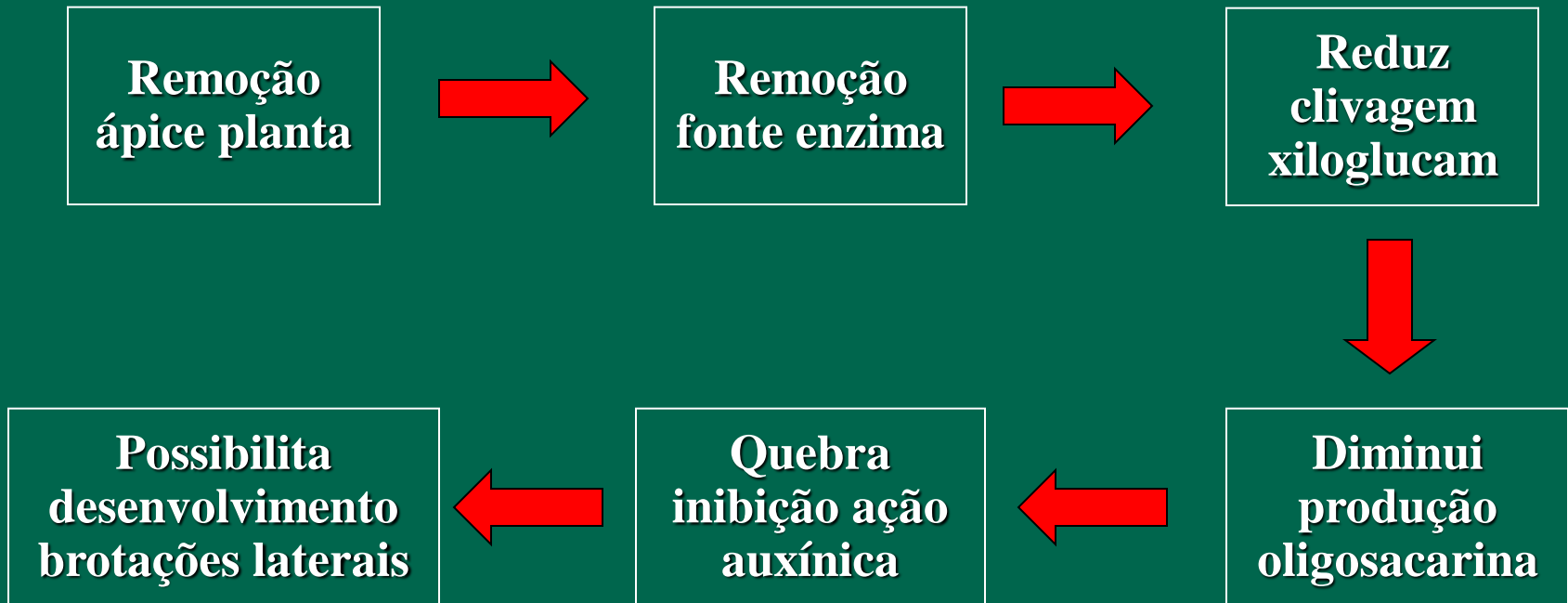
| <b>Eficiente</b> | <b>Variável</b>  | <b>Emergência e perfilhamento</b> |
|------------------|------------------|-----------------------------------|
| <b>SP70-1143</b> | <b>SP71-5368</b> | <b>SP70-1284</b>                  |
| <b>SP70-1284</b> | <b>SP71-6163</b> | <b>SP71-6163</b>                  |
| <b>SP 80-185</b> | <b>SP79-1011</b> | <b>SP79-1011</b>                  |
| <b>SP81-1763</b> | <b>RB72454</b>   | <b>RB765418</b>                   |
| <b>RB806043</b>  | <b>RB765418</b>  | <b>RB855156</b>                   |
| <b>RB825336</b>  | <b>RB785148</b>  |                                   |
| <b>RB835019</b>  | <b>RB855536</b>  |                                   |
| <b>RB835486</b>  |                  |                                   |
| <b>RB855113</b>  |                  |                                   |



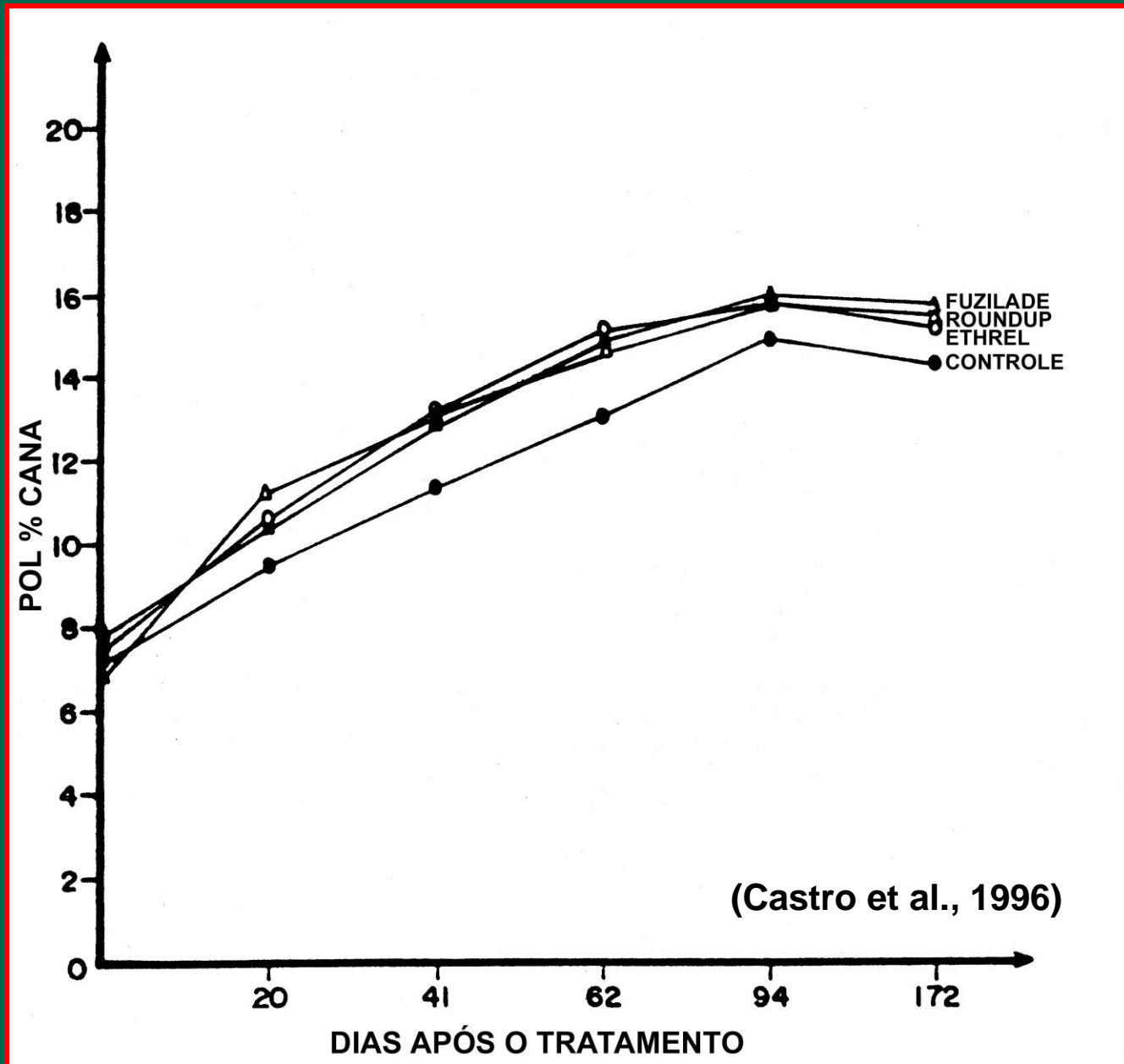
# MATURADORES DE CANA-DE-AÇÚCAR: ESTRESSE MODIFICADOR DE PARTIÇÃO DE FOTOASSIMILADOS



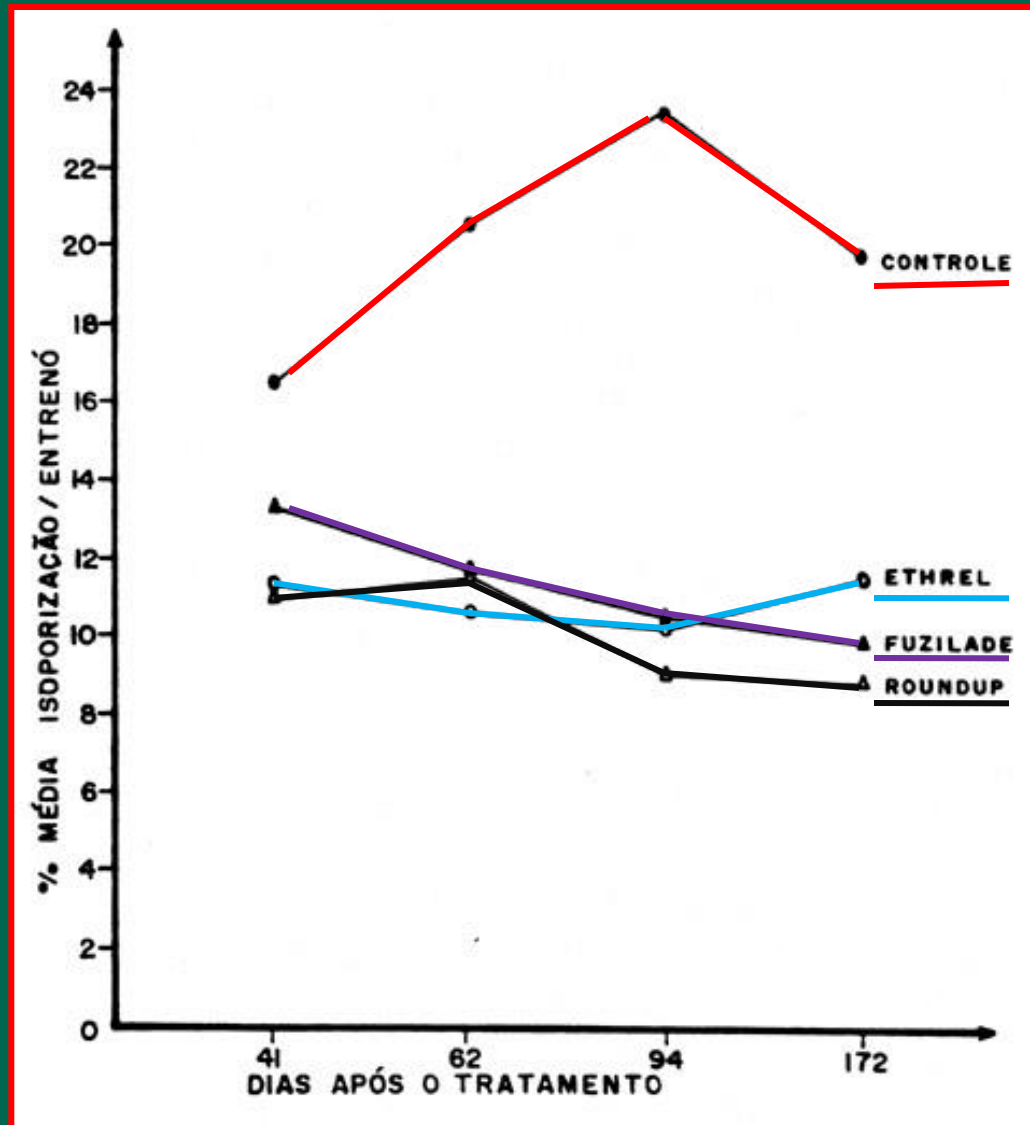
# EFEITO DA QUEBRA DA DOMINÂNCIA APICAL



# POL % CANA, SP70-1143 TRATADA COM MATURADORES

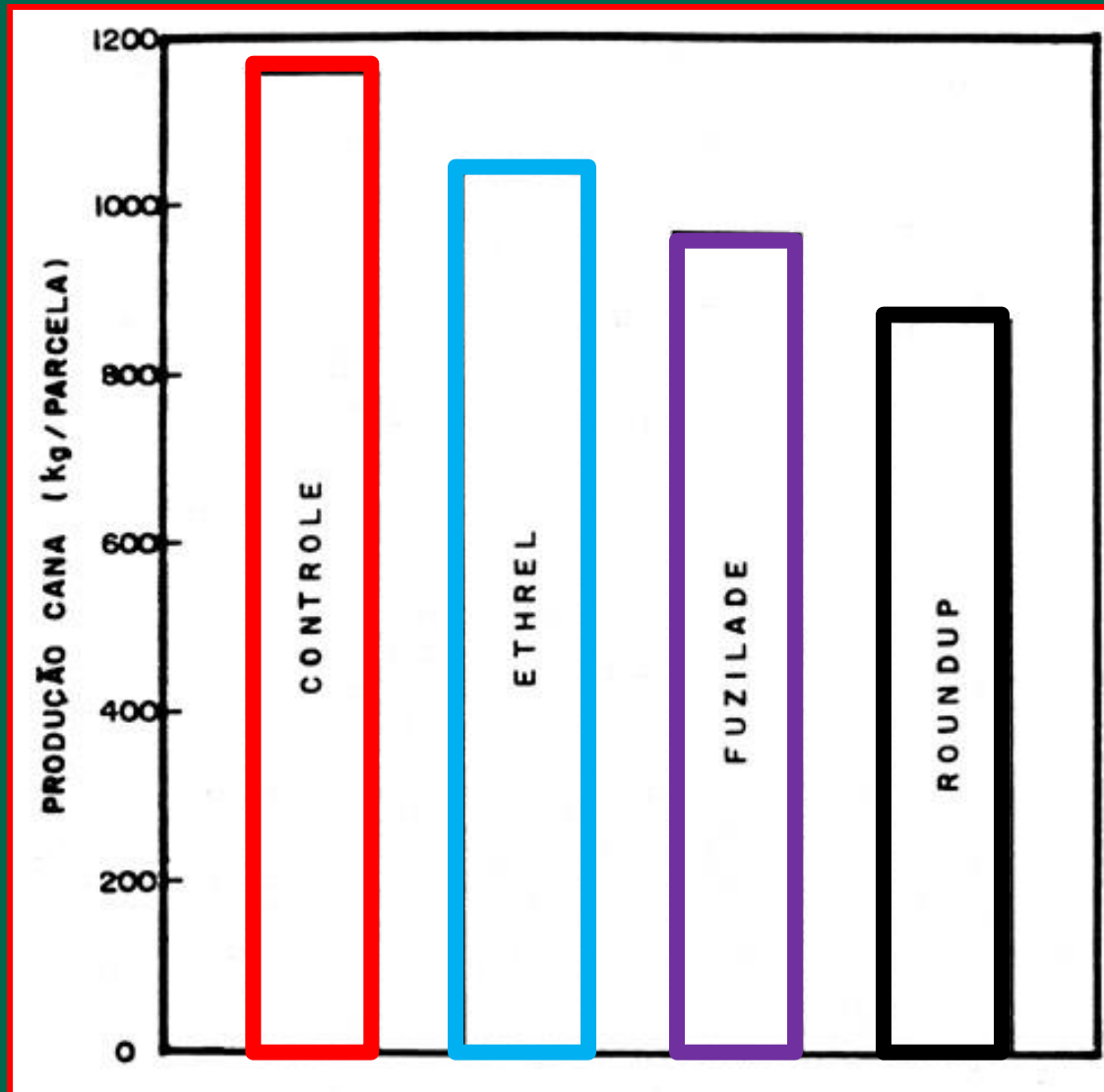


# ISOPORIZAÇÃO, SP70-1143 TRATADA COM MATURADORES





# PRODUÇÃO DA SP70-1144 TRATADA COM MATURADORES



# Cana







***OBRIgADO***

***prcastro@usp.br***