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Universidade de São Paulo

LFT5870 AGENTES CAUSAIS DE DOENÇAS DE PLANTAS: VÍRUS

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PARTE V

MOVIMENTAÇÃO DOS VÍRUS DE PLANTAS

1. INTRODUÇÃO

Infecção

Replicação

Invasão sistêmica

a) movimento a partir da primeira célula infectada

b) movimento da célula do parênquima para o tecido vascular

c) movimento do tecido vascular de volta para células do parênquima

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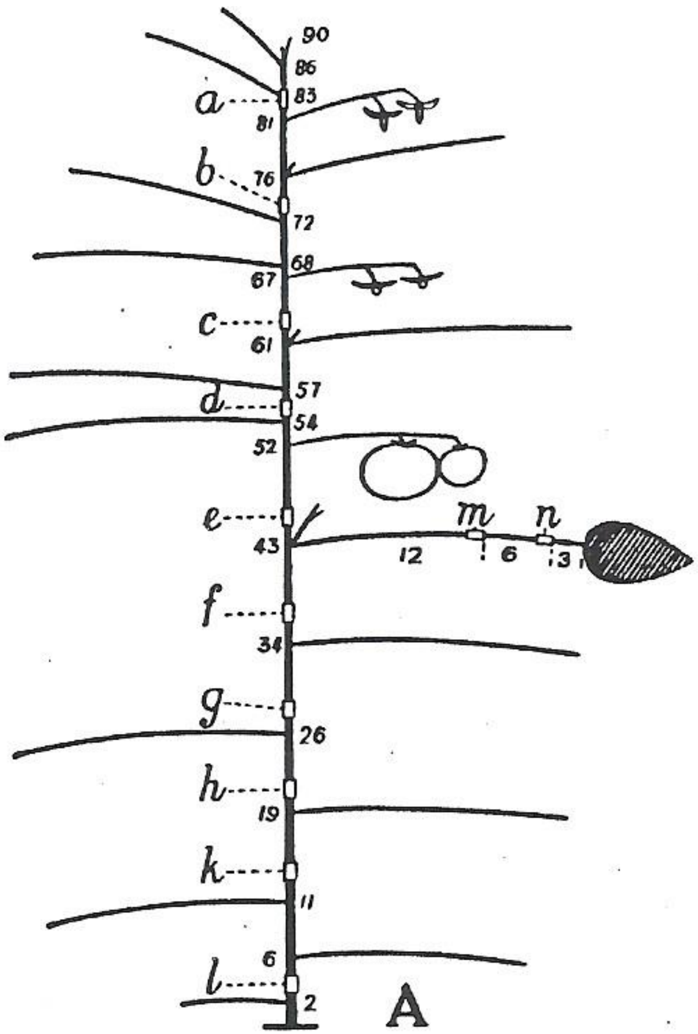
MOVIMENTO DO VÍRUS NA PLANTA

A. VISÃO GERAL

Samuel, G. 1934

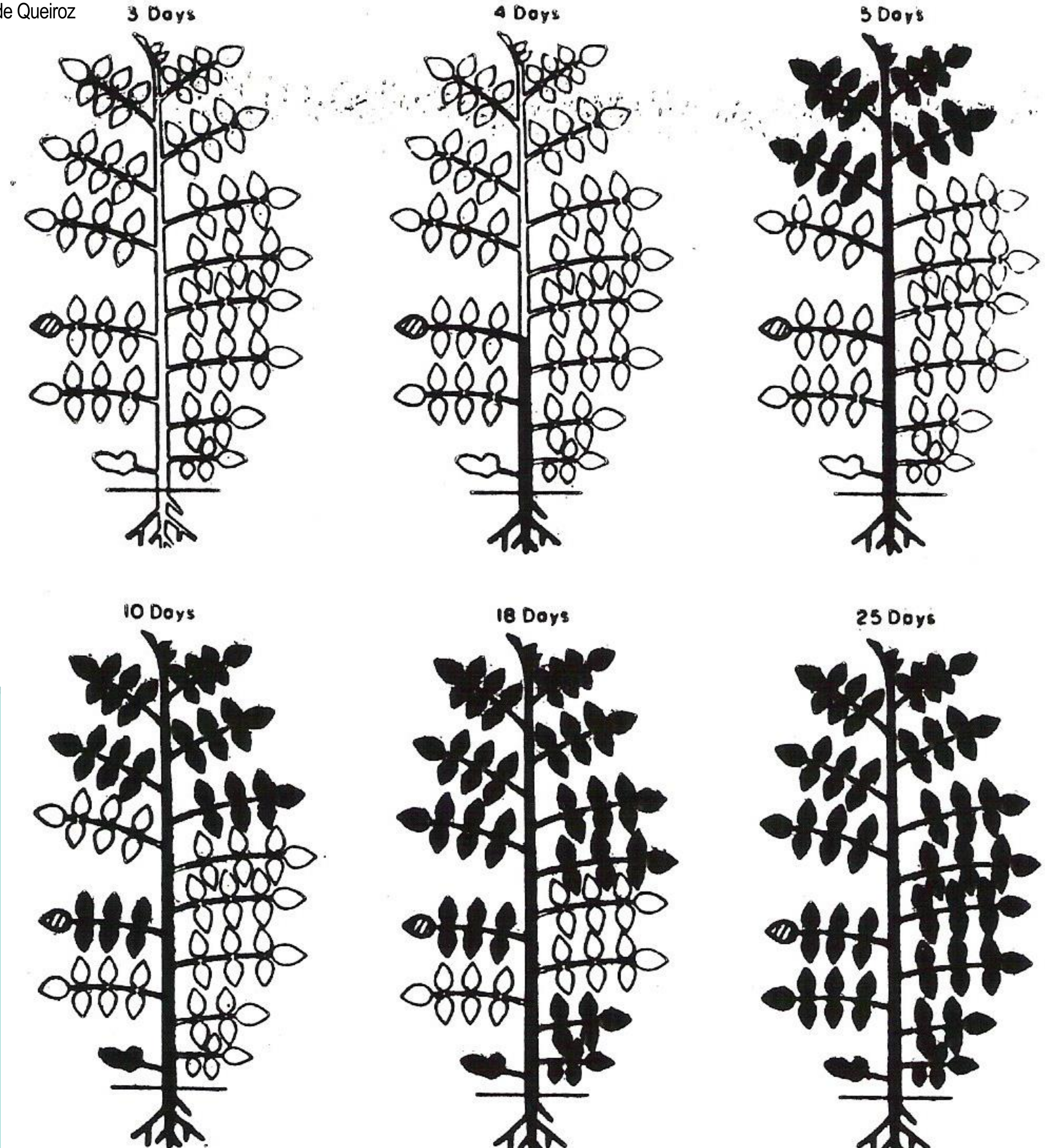


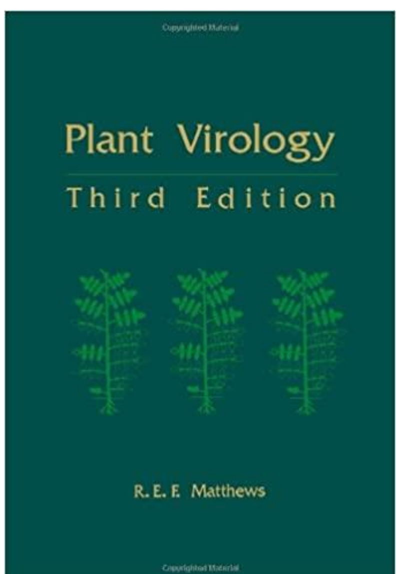
Inoc. *N. glutinosa* lesão local

Inoc. *N. tabacum* sistêmico

Enraizamento

Tubo de ensaio 1 semana inoc. *N. glutinosa* lesão local


3 Days
4 Days
5 Days
10 Days
18 Days
25 Days


Plant Virology
Third Edition
R. E. F. Matthews

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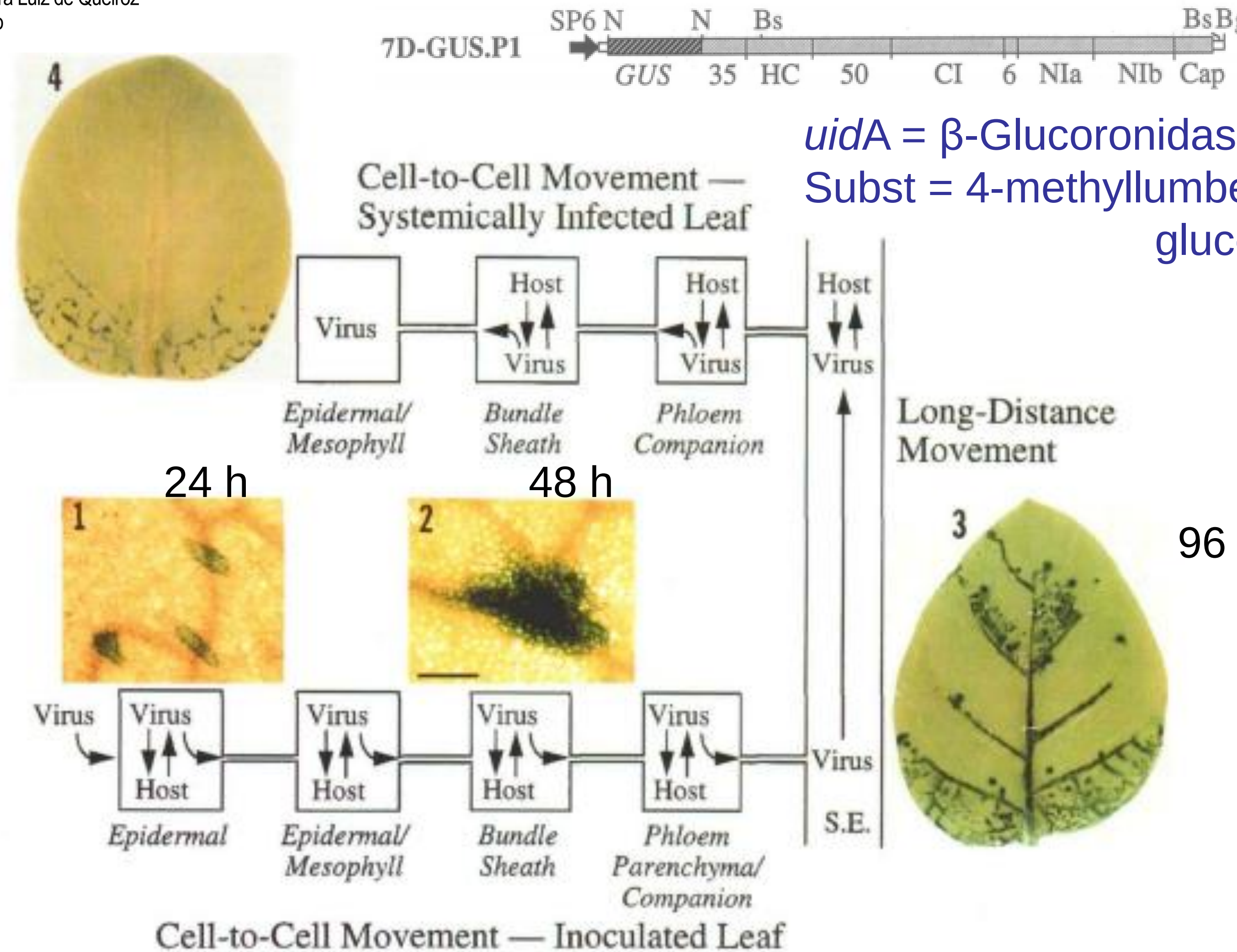
Tobacco etch virus

*uid*A = β-Glucoronidase (GUS)
Subst = 4-methyllumbelliferyl glucorinade



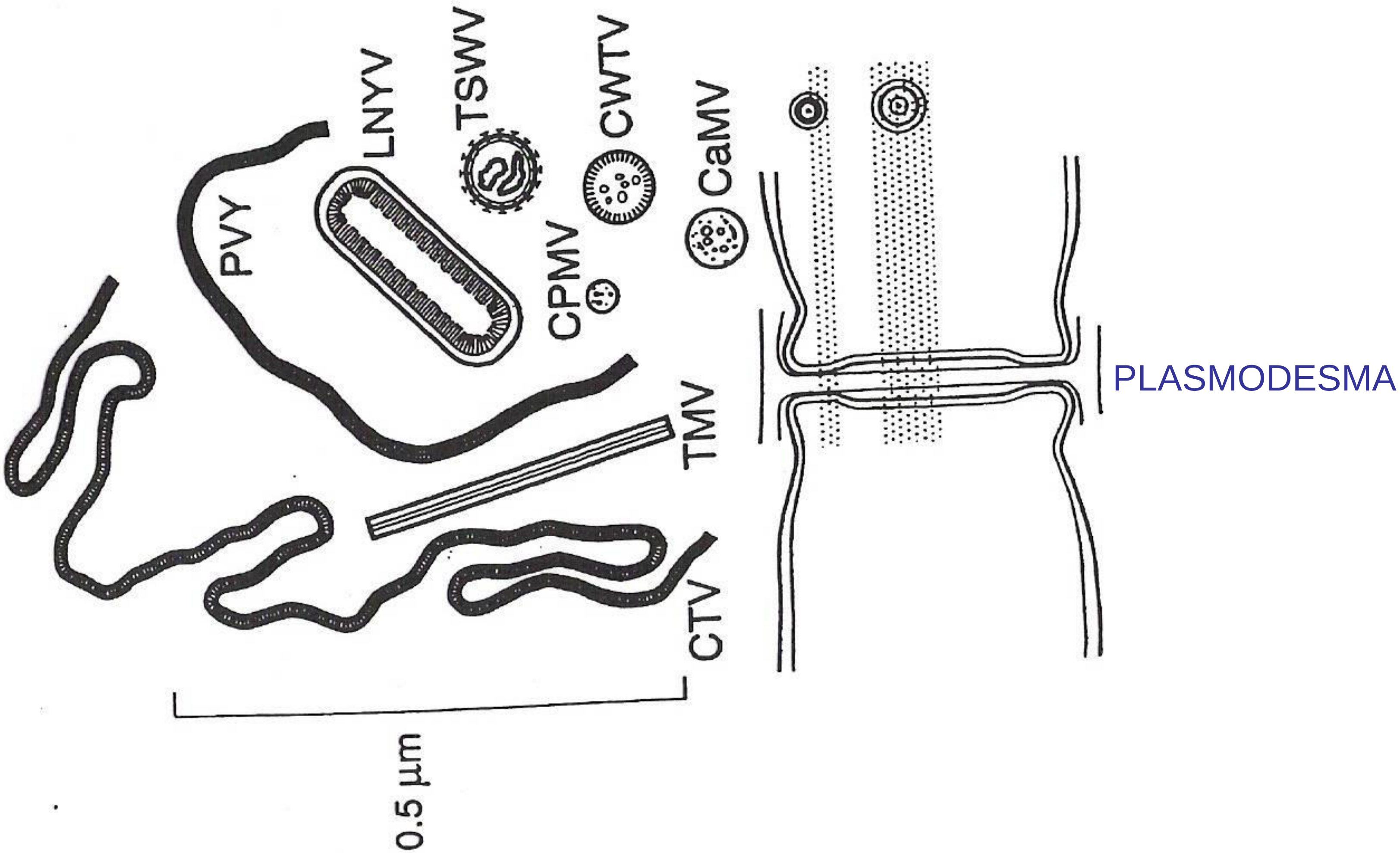
Carrington et al.,1996

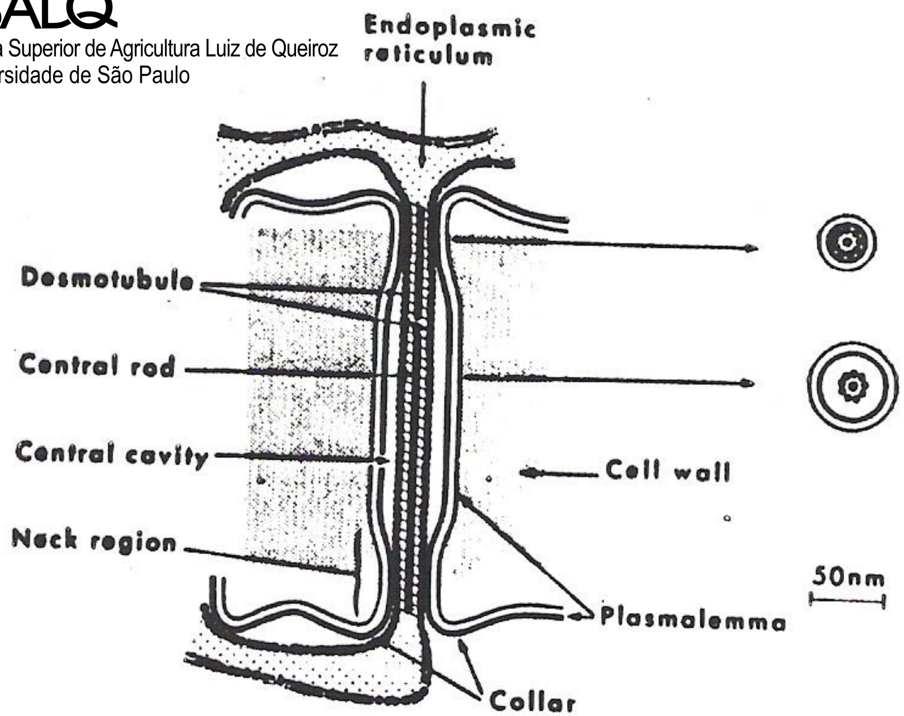
Figure 1. Cell-to-Cell and Long-Distance Movement Pathway in Plants.

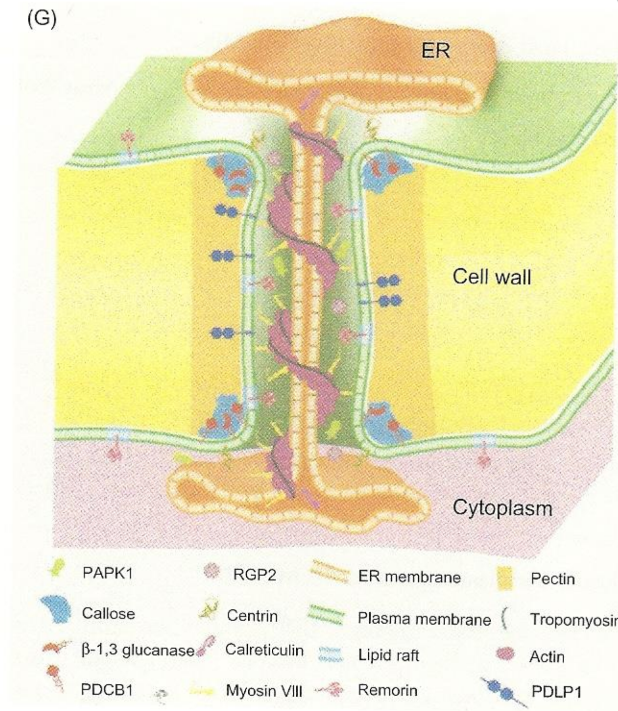
Several points along the pathway are illustrated schematically, using TEV-GUS infection of Arabidopsis (1 and 2) or tobacco (3 and 4). Photographs 1 to 3 show the extent of TEV-GUS movement at 24-hr postinoculation (p.i.), 48-hr p.i., and 96-hr p.i., respectively, in inoculated leaves. Virus is evident only in initially inoculated epidermal cells at 24-hr p.i. (1) and in foci resulting from cell-to-cell movement at 48-hr p.i. (2). Primary infection foci and secondary spread through the vasculature are detected in the inoculated leaf at 96-hr p.i. (3). Photograph 4 shows long-distance movement of TEV-GUS to an upper, noninoculated leaf, where virus is moving cell to cell after exiting the vasculature. Infected cells were visualized by infiltration with the colorimetric GUS substrate 5-bromo-4-chloro-3-indolyl β-D-glucuronic acid (X-gluc), as described by Dolja et al. (1992). Photographs 3 and 4 are from Verchot and Carrington (1995; reprinted with permission of the American Society for Microbiology) and Dolja et al. (1992), respectively. The scale for photographs 1 and 2 is indicated by the bar in photograph 2 (200 μm). The interactions between virus and host and the direction of virus movement are represented by arrows in the schematic diagram. S.E., sieve element.

B. MOVIMENTO DE CÉLULA PARA CÉLULA

1. TRANSPORTE INTRACELULAR E INTERCELULAR







DIMENSIONS OF PLASMODESMATA (nm)

	Outer diameter of plasmalemma	Inner diameter of plasmalemma	Outer diameter of desmotubule	Inner diameter of desmotubule	Central rod'
Azolla, young root cortical cells	35	25	16	7	3
Hordeum, young root (4 mm from tip) endodermal cells	46	33	20	9	3
Hordeum, older root (120 mm from tip) endodermal cells	60	44	20	10	4
Abutilon, distal cross-wall of stalk cell of nectary hair	44	29	16	10	3

From: Robards, A. W., Plasmodesmata in higher plants, in *Intercellular Communication in Plants: Studies on Plasmodesmata*, Gunning, B. E. S. and Robards, A. W., Eds., Springer-Verlag, Berlin, 1976, 15. With permission.

2. ESTRATÉGIAS DE MOVIMENTO:

a) TMV (super família proteína 30K)

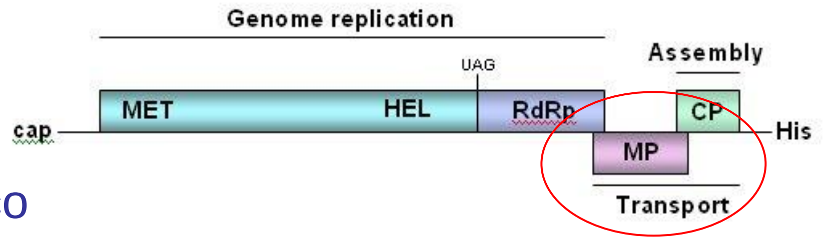
b) Tubular

c) “Triple gene block”

d) Potyviruses

e) Geminiviruses

ESTRATÉGIA DO TMV



TMV - proteína 30 K.

a) Associa-se ao ácido nucléico

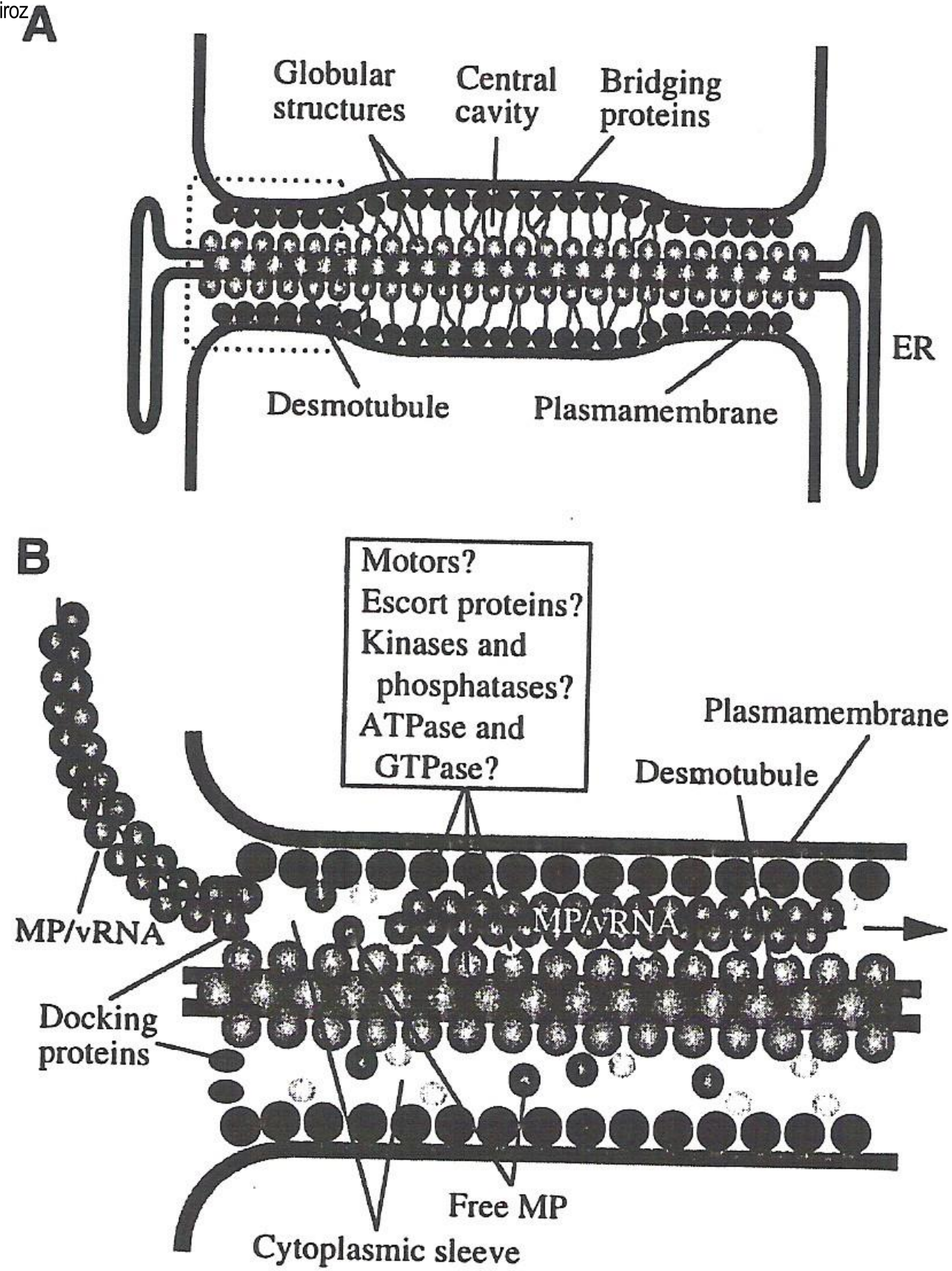
b) Aumenta diâmetro de plasmodesma, localiza-se e acumula-se neste

c) Facilita o movimento do RNA para a célula vizinha

d) planta transgênica

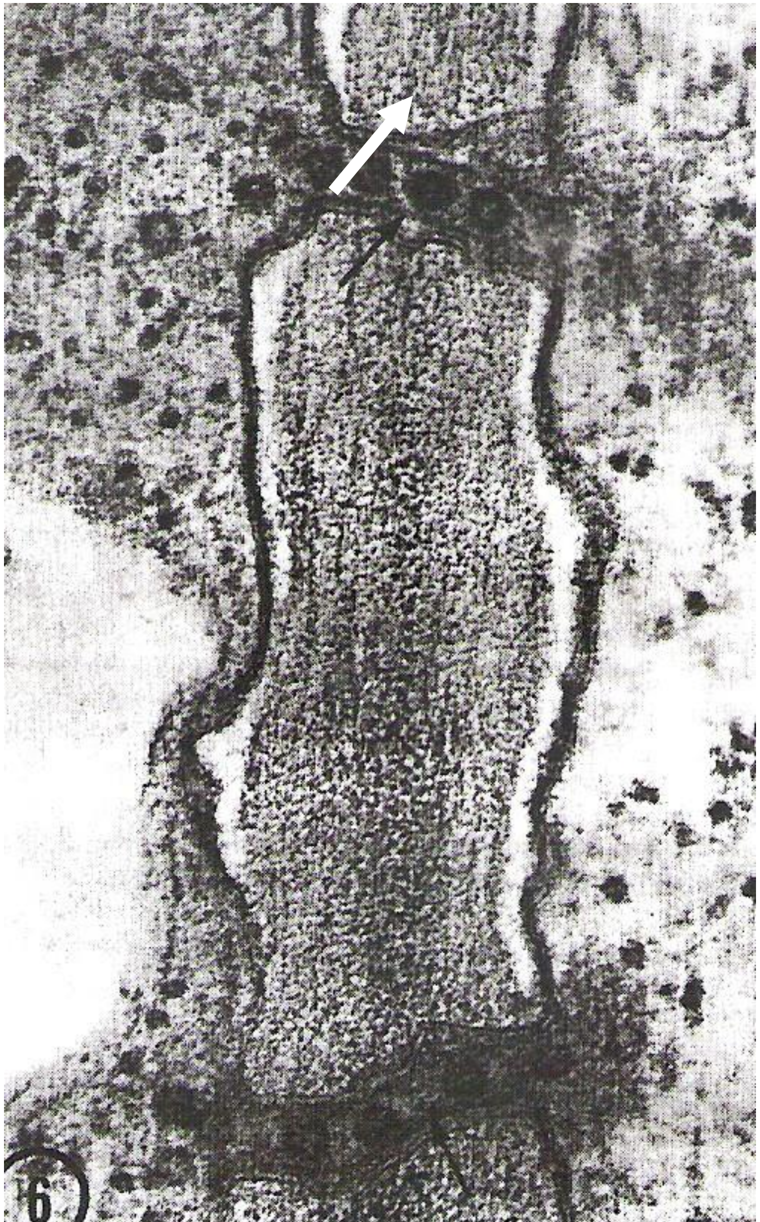
Isolado LS1 não é sistêmico a 32° C.

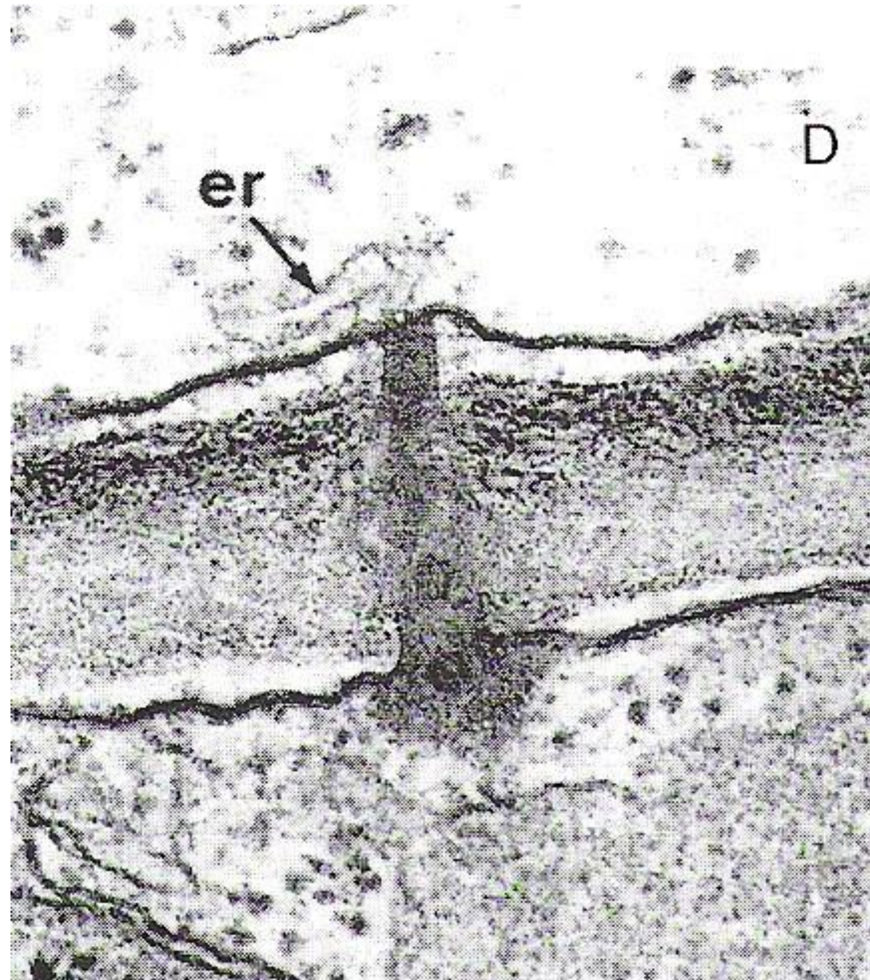
Em plantas transgênicas que produzem a proteína 30 K, LS1 invade sistemicamente.


A
Globular structures
Central cavity
Bridging proteins
ER
Desmotubule
Plasmamembrane
B
Motors?
Escort proteins?
Kinases and phosphatases?
ATPase and GTPase?
Plasmamembrane
Desmotubule
MP/vRNA
MP/vRNA
Docking proteins
Free MP
Cytoplasmic sleeve

Estratégia Tubular

Vírus do mosaico da dália (Caulimovirus)
Kitajima & Lauritis, 1969



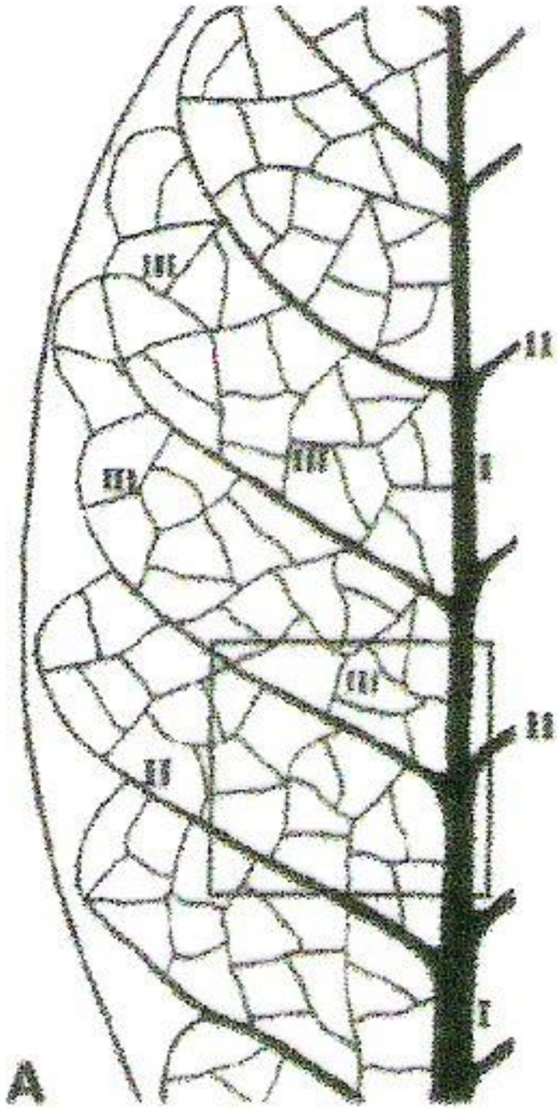


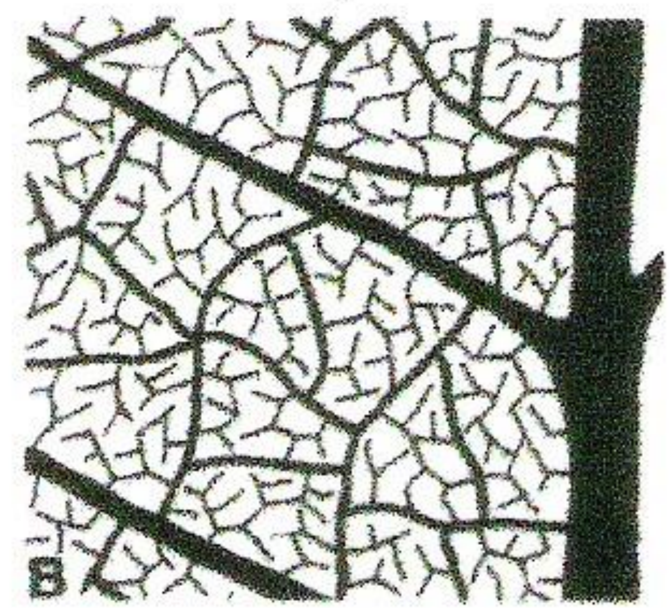
C. MOVIMENTO A LONGA DISTÂNCIA

- RÁPIDO
- Vírus sai do parênquima e vai para o floema.
- Movimento com produtos da fotossíntese.
- Envolvimento de proteína de transporte
- EX:

TMV: deleções ou adições no genoma que codifica
a capa protéica (17,5 K) alterou o movimento sistêmico.

Nervuras “maiores e menores” em dicotiledôneas





Nervuras I, II, II: transporte de H_2O, nutrientes inorgânicos e produtos da fotossíntese. Descarregamento desses

Nervuras IV e V carregamento de produtos da fotossíntese em folhas maduras.

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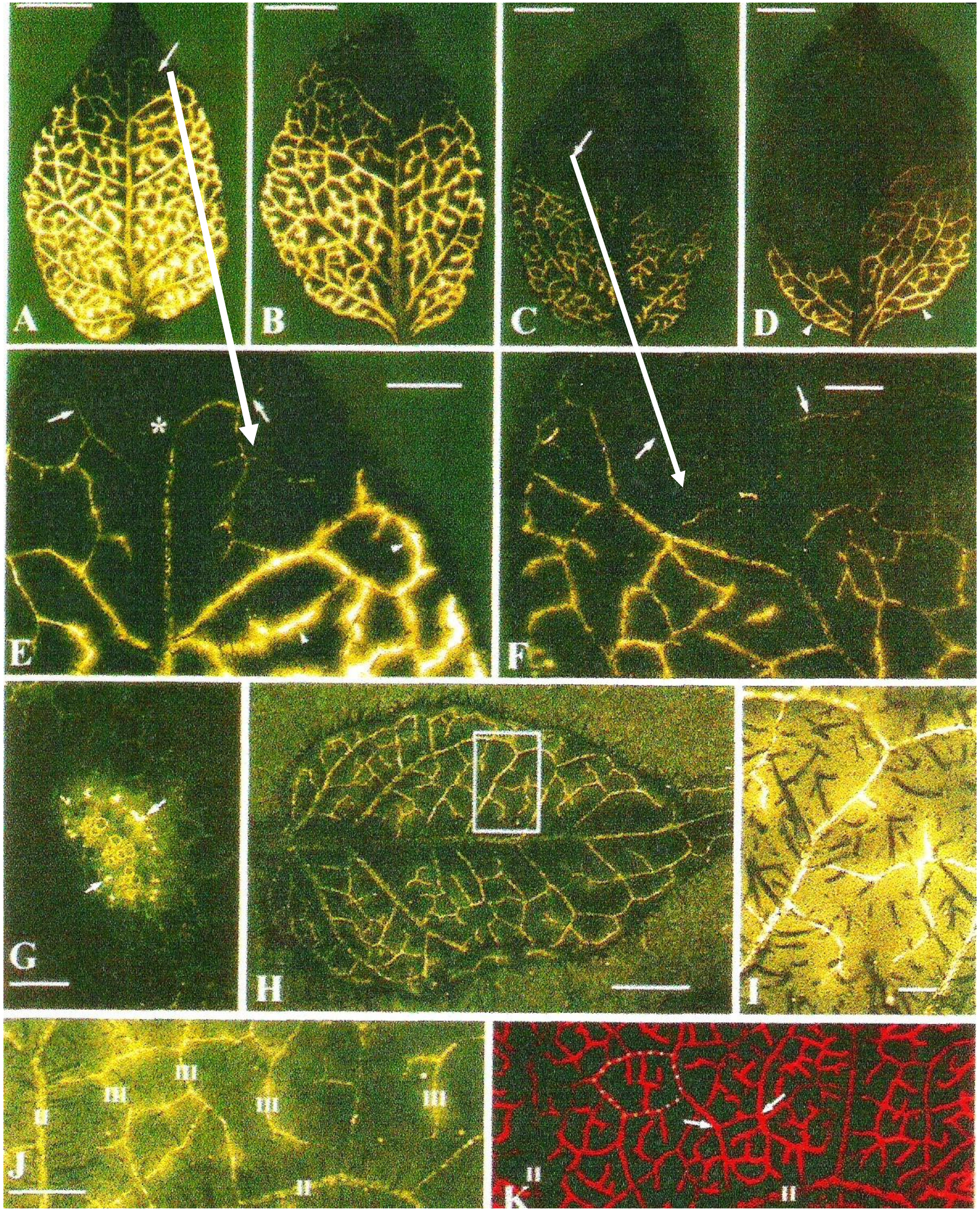
Transição dreno-fonte



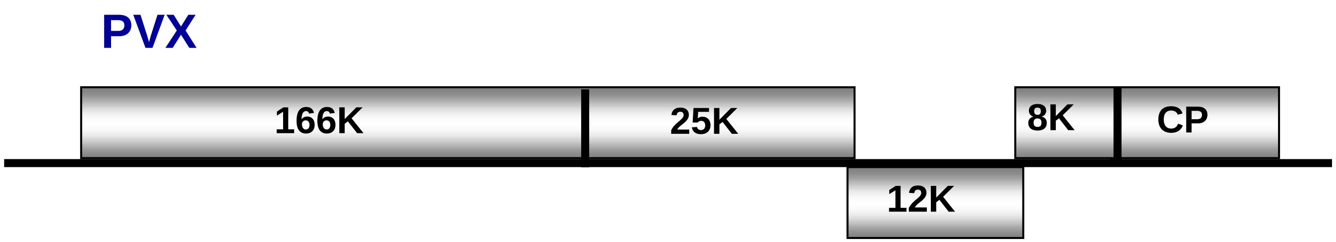
Corte transversal do pecíolo: floema marcado

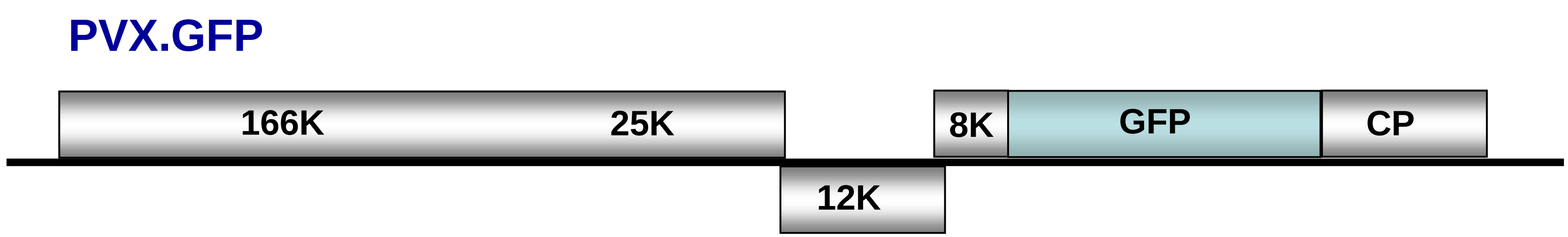
Carboxyfluorescein

Texas Red dextran

Roberts et al., 1997

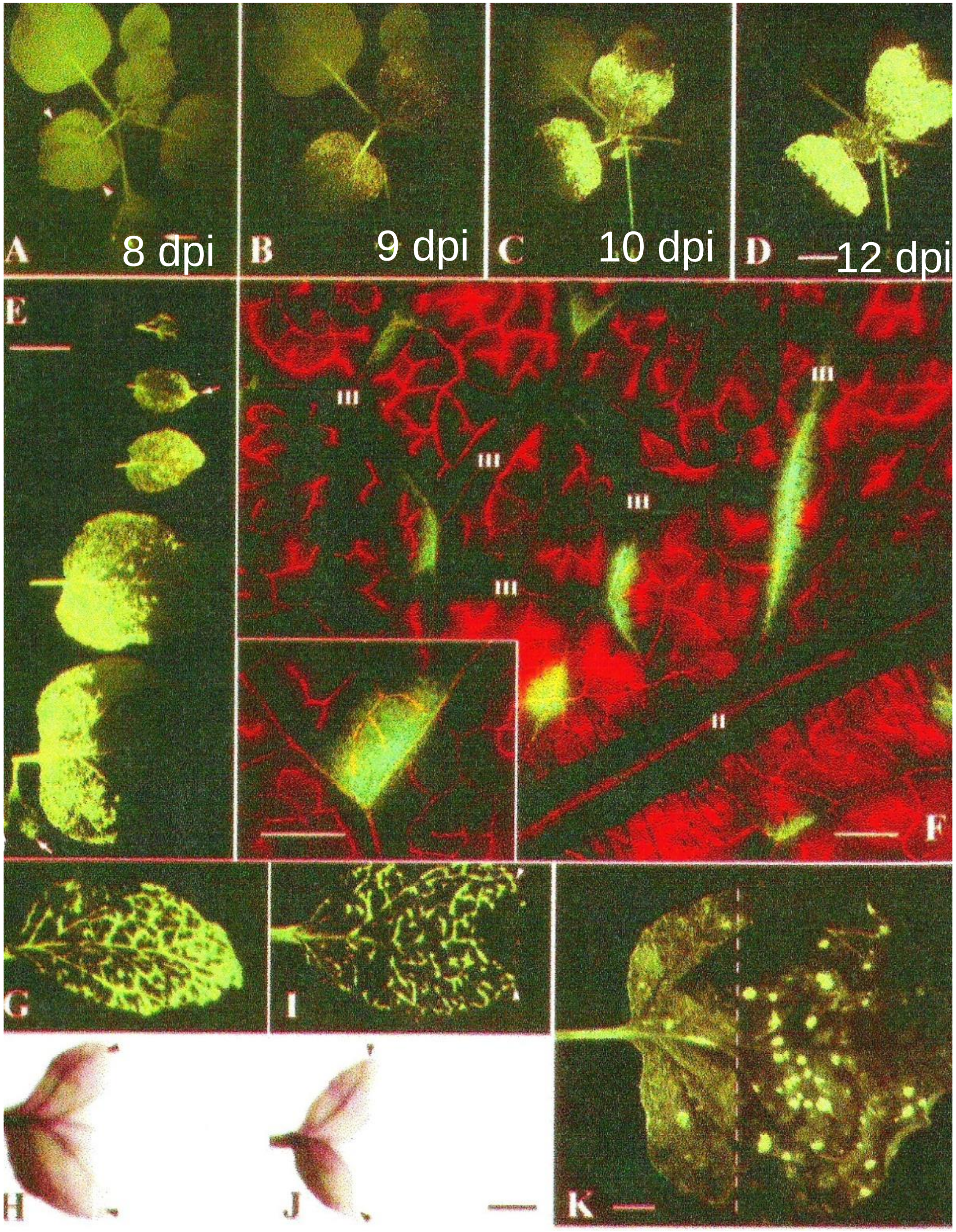
Potato virus X (PVX)





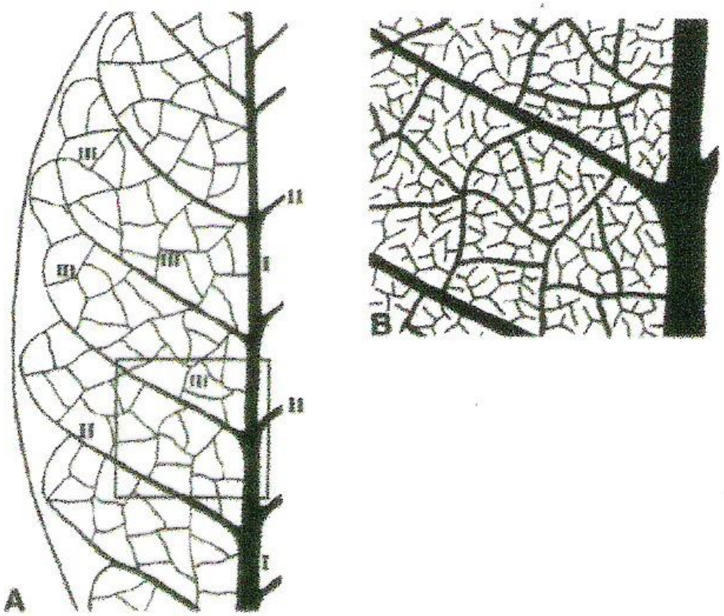
"green fluorescent protein"

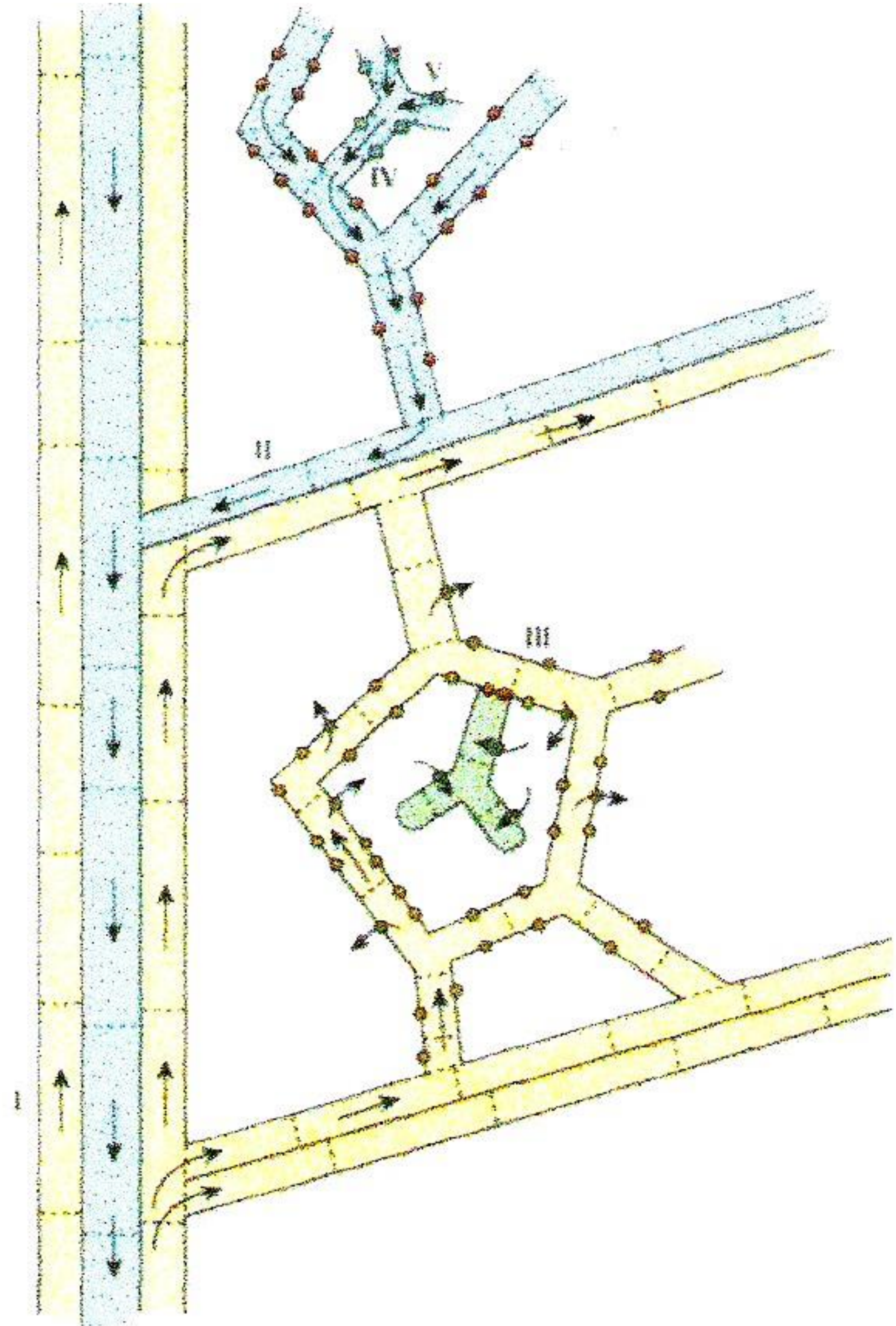
Folha inoculada: seta



Folhas destacadas do ápice

PVX + GFP





Fonte = azul (exporta)

Dreno = amarelo

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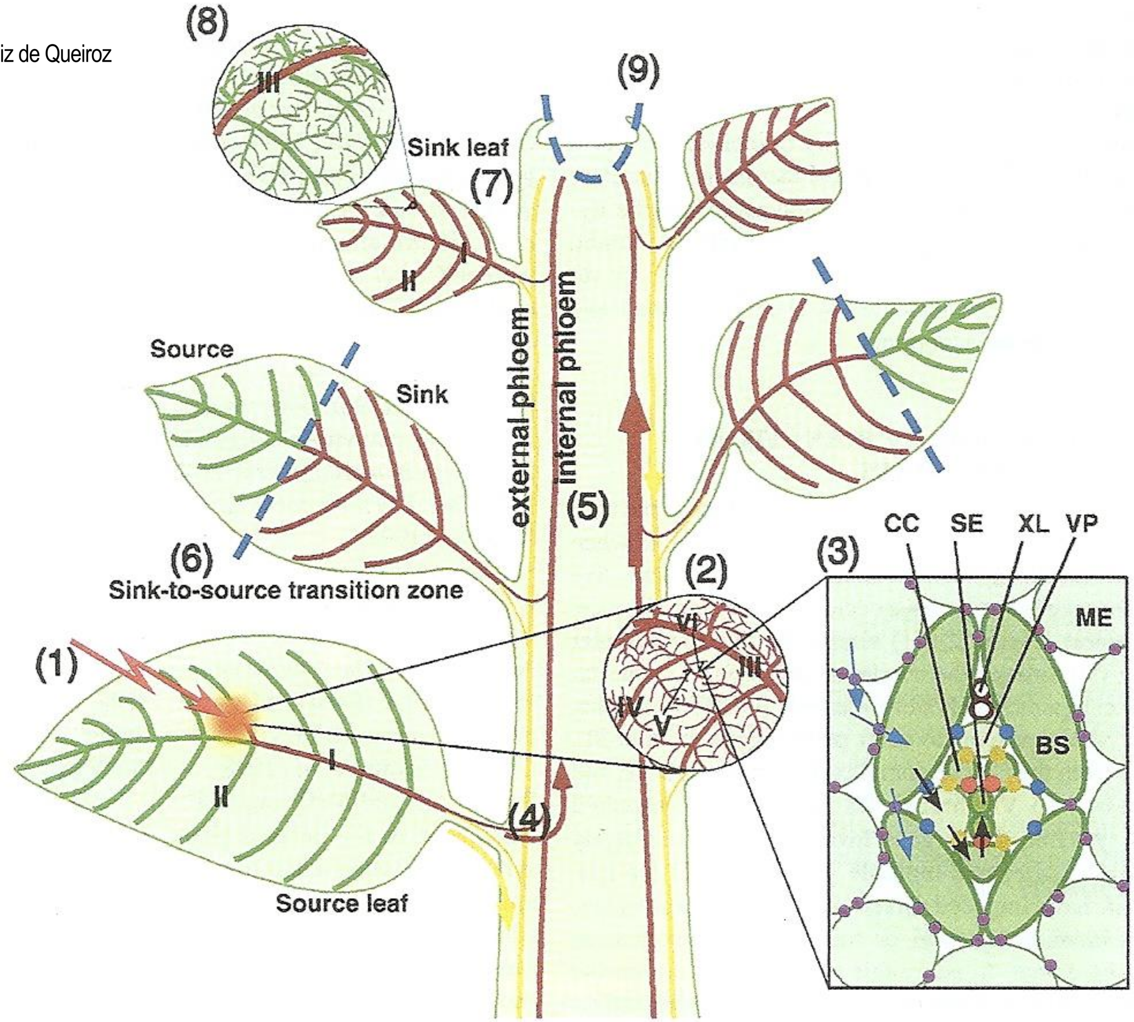

FIGURE 10.11 Cellular route for systemic movement of plant viruses. Leaf veins used by viruses for systemic transport are shown in red and yellow; those not used shown in green. Blue dotted lines indicate cellular boundaries that viruses are unable to cross, that is, sink/source transition zones and apical meristem. (1 and 2) Viral infection initiates with mechanical damage (red jagged arrow) of mesophyll cells of a lower source leaf. The virus spreads from cell to cell and reaches the vascular system where it is trafficked towards systemic organs but not locally. (3) To enter the phloem the virus has to cross from mesophyll (ME) cells through bundle sheath (BS) cells and phloem parenchyma (VP) into companion cells (CCs) and then into the sieve elements (SEs) of the phloem. This movement involves viral MPs (blue arrows) and is through plasmodesmata (pink circles). Additional factors (black arrows) are required for movement BS>VP>CC>SE. (4 and 5) Once within the SEs virus passes out of the inoculated leaf and spreads rapidly upwards using the internal, adaxial (red) phloem and slowly downwards in the external, abaxial (yellow) phloem. (6–8) Virus enters the sink, but not the source, zones, unloading only from major veins (classes 1–3, indicated in red). (9) Virus does not enter the apical meristem. *From Waigmann et al. (2004) with permission of the publishers.*

Hull, 2014