

# Walnut Blackline Disease

Dr. Kari Arnold

Walnut Production Course

Nov. 7<sup>th</sup>, 2018

# A tale of two genotypes

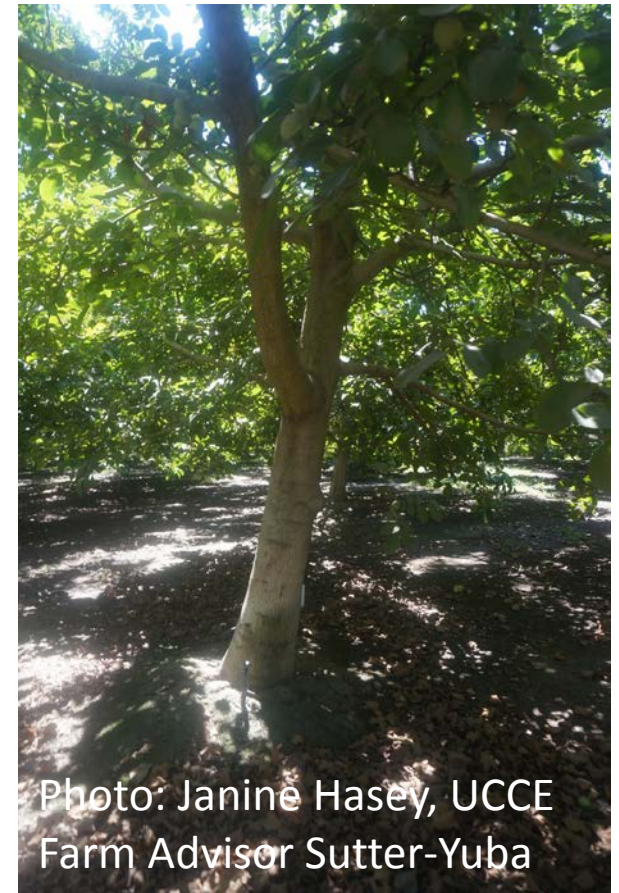


Photo: Janine Hasey, UCCE  
Farm Advisor Sutter-Yuba

# Viruses, resistance genes and HR

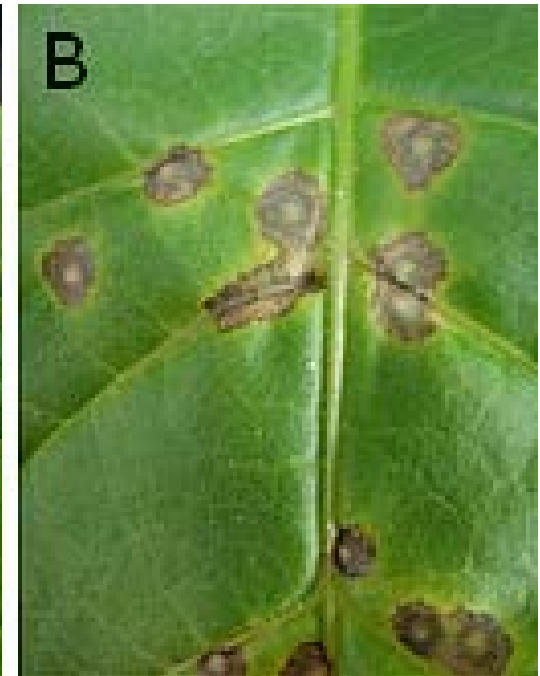
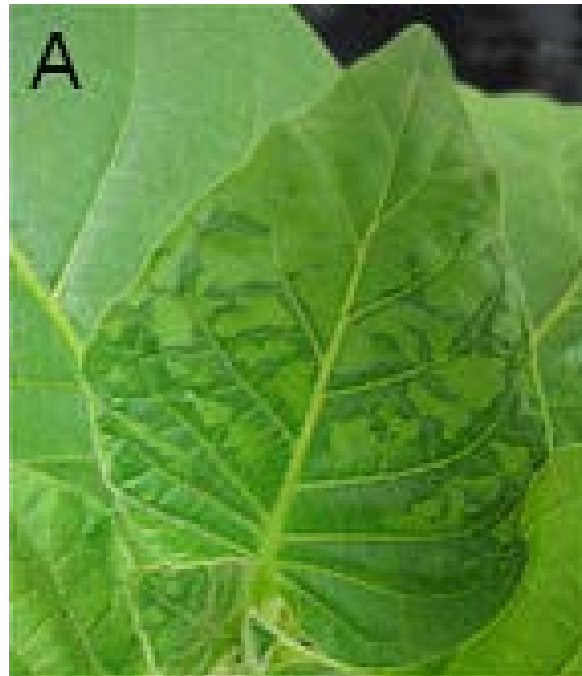
Systemic infection

N-gene resistance

“Leaden-gray color”

“Extremely bitter to the taste”

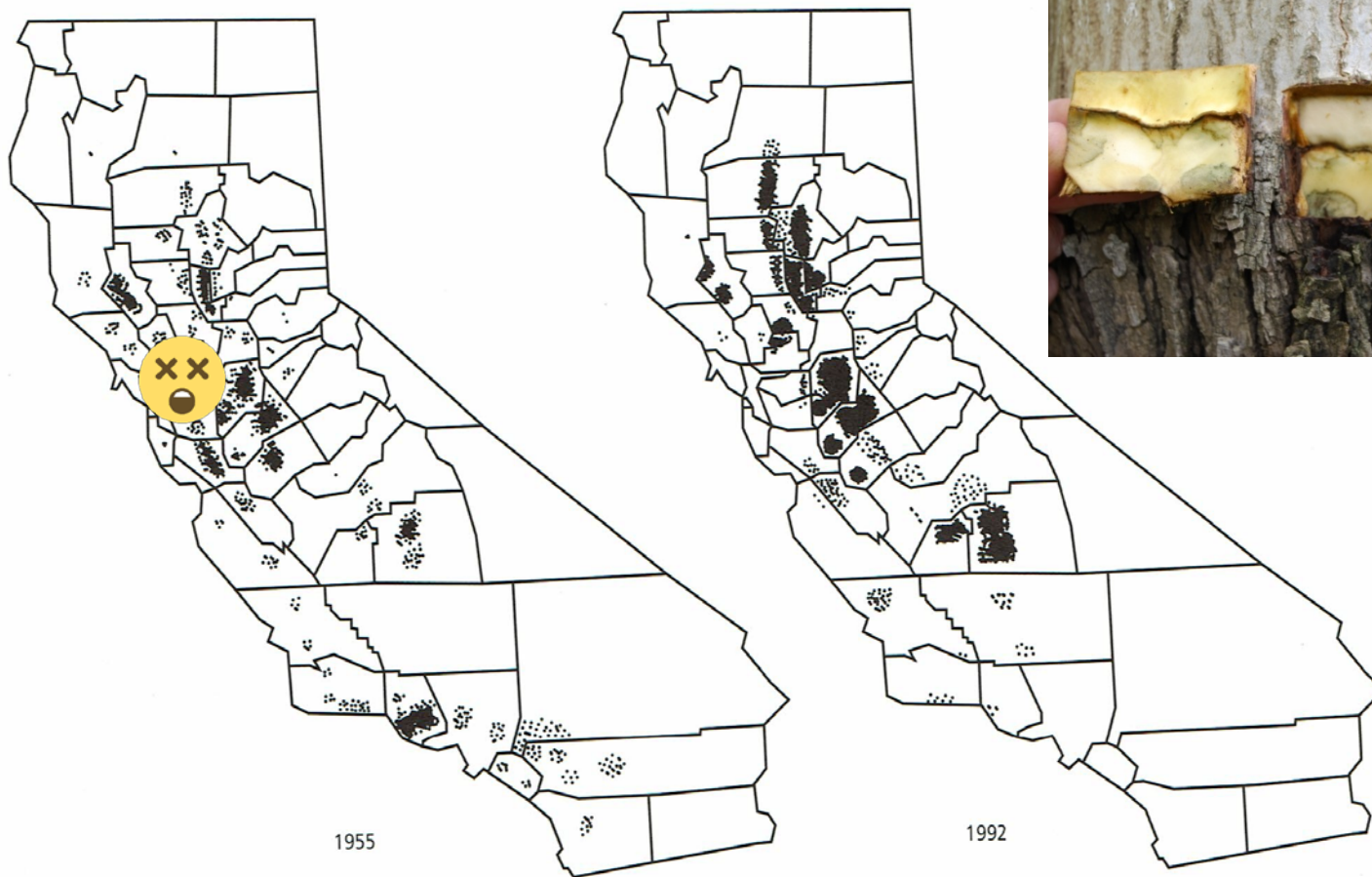
Decimated the industry (late 1800s)



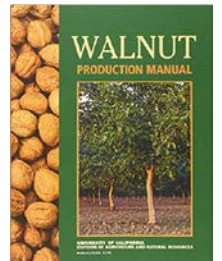
<https://www.apsnet.org/publications/apsnetfeatures/Pages/TMV.aspx>

Scholthof, KB.G. 2008. Tobacco Mosaic Virus: The Beginning of Plant Pathology. Online. *APSnet* Features. doi: 10.1094/APSnetFeatures-2008-0408

# 1929-Walnut Creek, CA



**Figure 2.1** Walnut acreage distribution and production areas in California, 1955 and 1992. Each dot represents 100 acres of walnut. 1955 state acreage: 138,450 acres. 1992 total: 190,204 acres, 15,371 nonbearing.





# Fast forward to the 1970s...



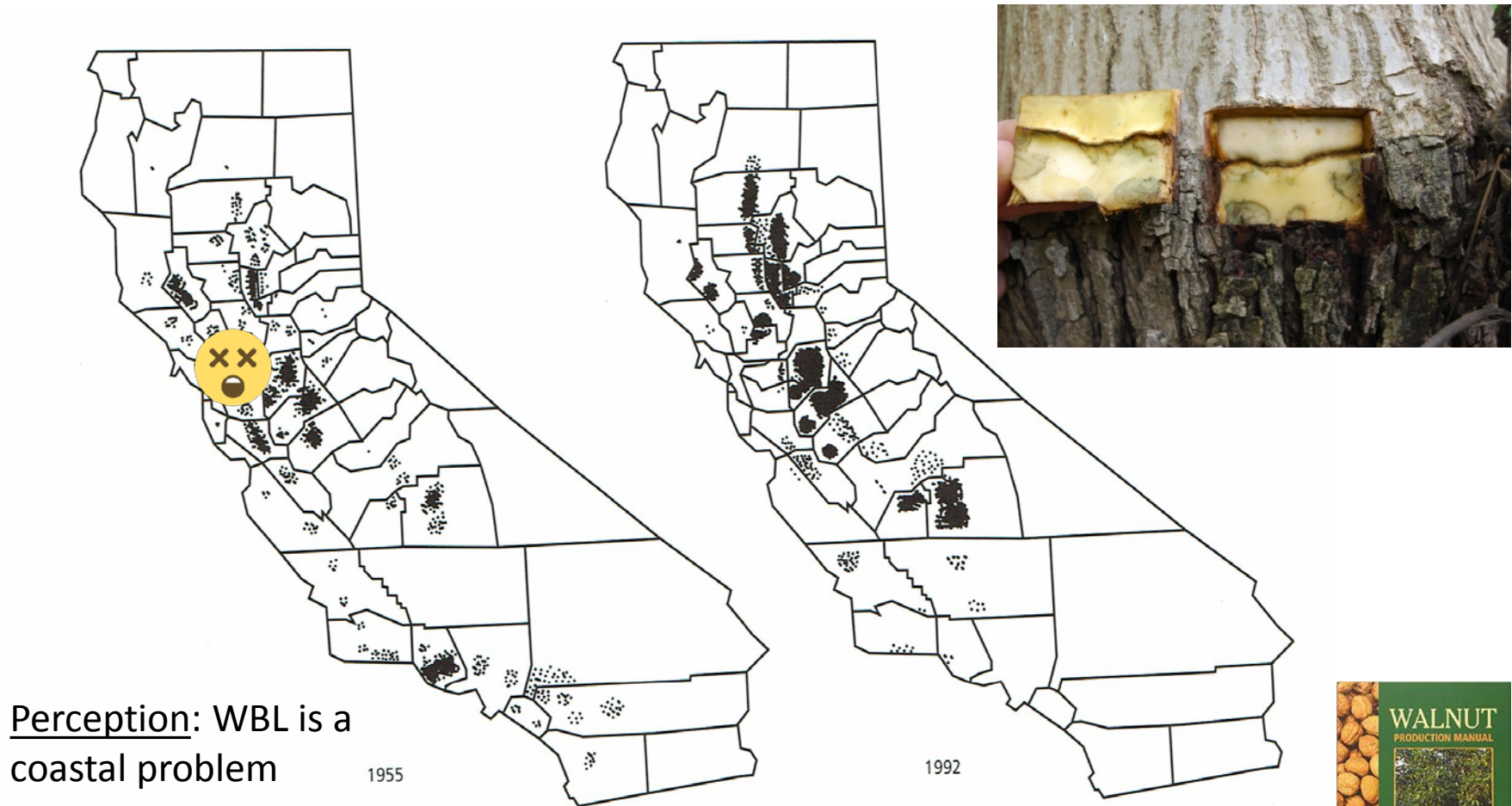


# Sacramento and Northern San Joaquin Valleys

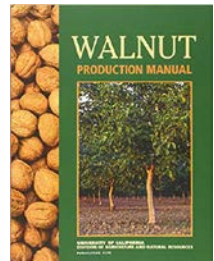




# 1929-Walnut Creek, CA



**Figure 2.1** Walnut acreage distribution and production areas in California, 1955 and 1992. Each dot represents 100 acres of walnut. 1955 state acreage: 138,450 acres. 1992 total: 190,204 acres, 15,371 nonbearing.



# Srecko Mirko 'John' Mircetich

- 1971
  - Growers reporting blackline
  - Industry requests assistance from USDA
    - Dr. Mircetich is relocated from Beltsville, MD to Davis, CA
      - Plant pathologist
      - Walnut blackline and phytophthora



Photo credit: Jack Kelly Clark





Dr. Dave Ramos, UC Walnut Specialist



Photo credit: Jack Kelly Clark

Dr. Mircetich, USDA









“We need  
to map  
this...”

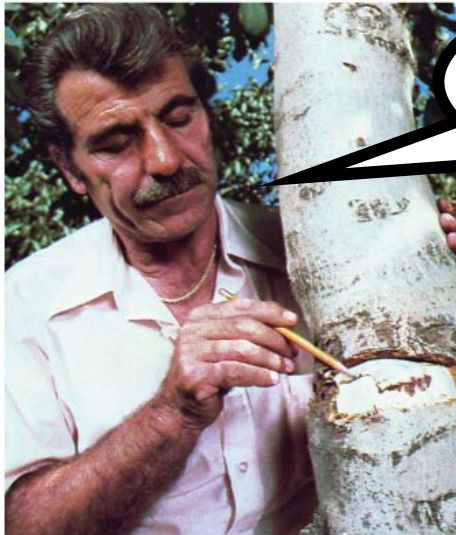
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Photo credit: Jack Kelly Clark

Dr. Mircetich, USDA

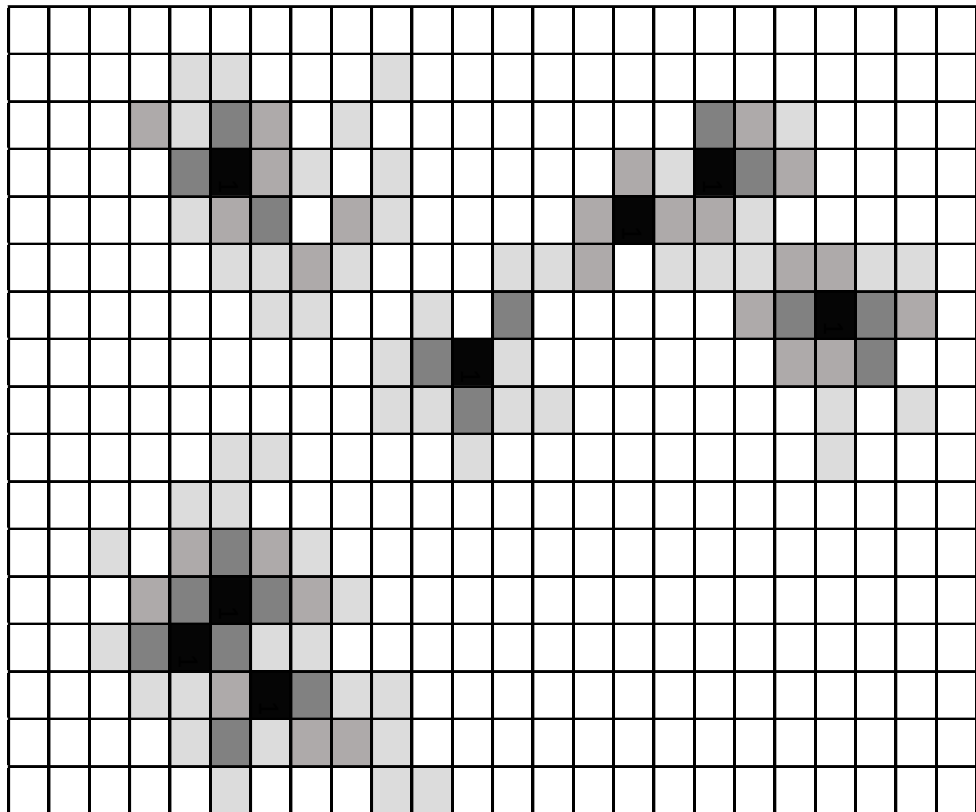




"This is spreading..."

Photo credit: Jack Kelly Clark

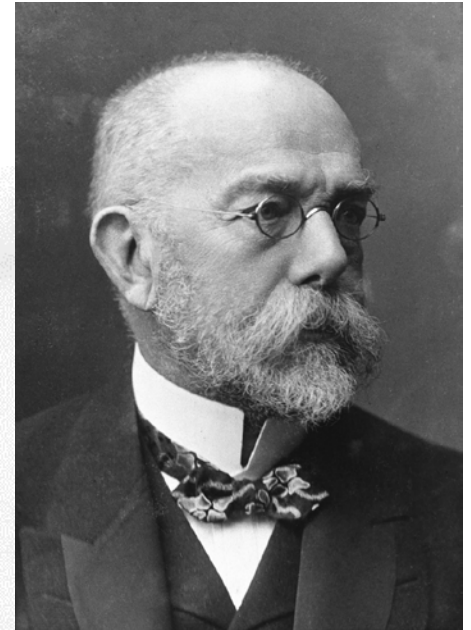
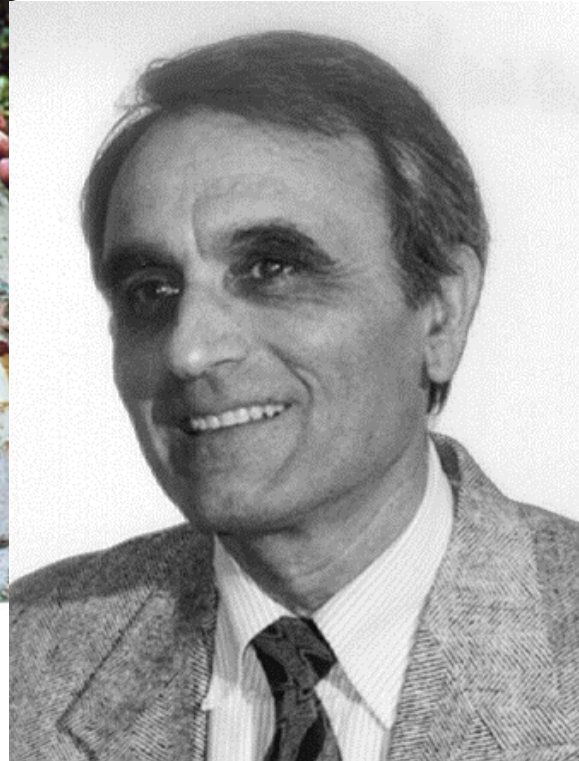
COLOR	YEAR
	1
	2
	3
	4
	HEALTHY



# Koch's Postulates and ELISA



Dr. Adib Rowhani, USDA,  
FPS UC Davis Plant  
Pathology



Robert Koch  
Koch's Postulates

Photo credit: Jack Kelly Clark

# Walnut Blackline

- Graft transmissible
- Cherry leafroll virus
  - Present in english scion
  - Not present in black walnut rootstock

Why????





# Viruses, resistance genes and HR

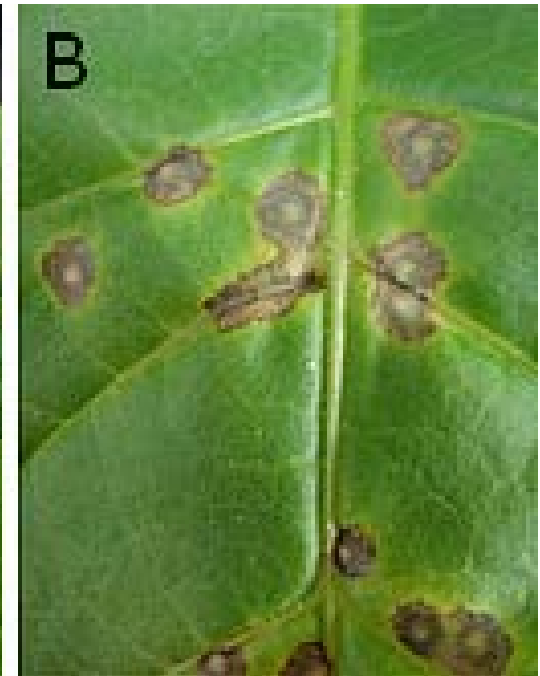
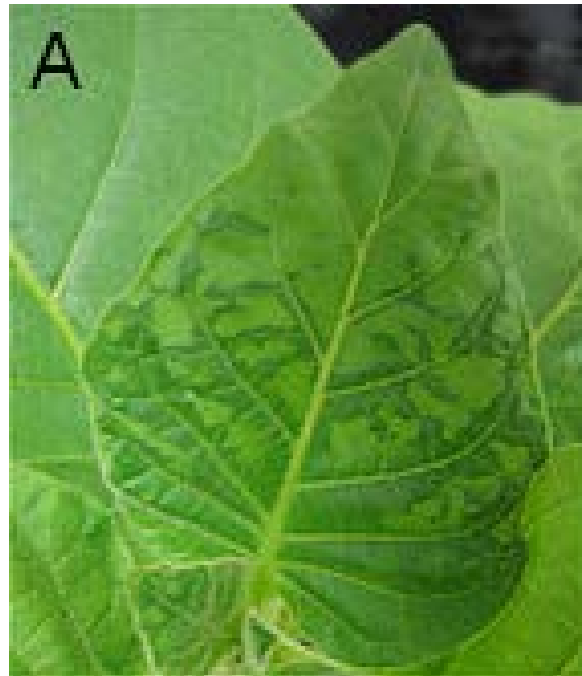
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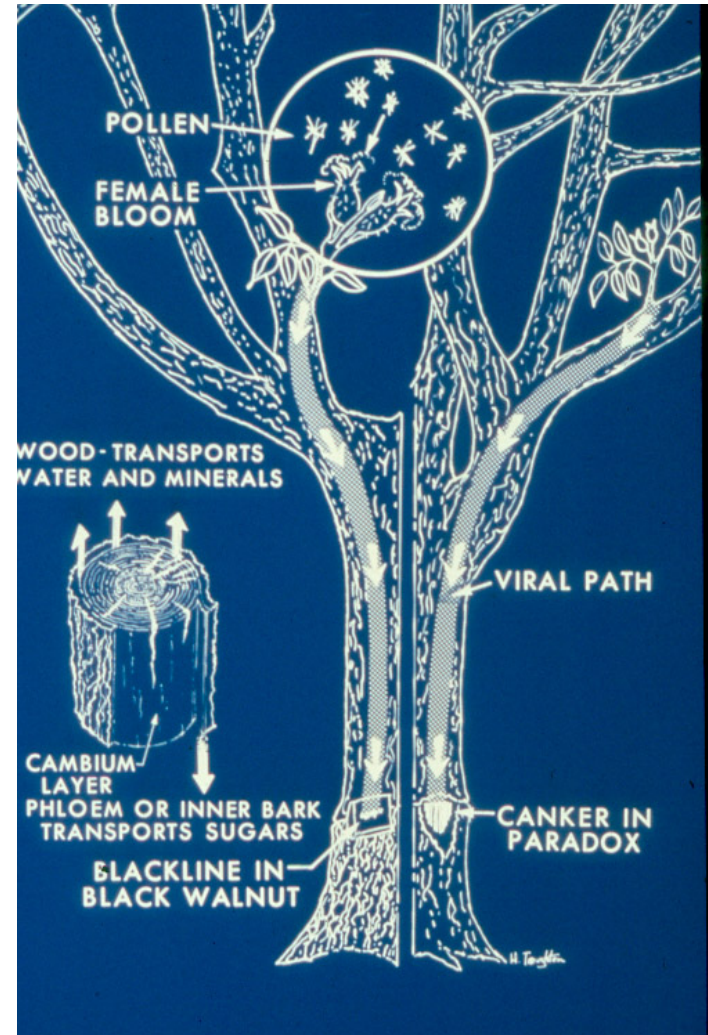


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# HR in CA Black Walnut

- Cherry leafroll virus
- Infected pollen
- Infects female bloom
- Virus enters tree
- English is tolerant
  - No symptoms
- Black/Paradox are hypersensitive
- Virus kills cells at union
- A disease of middle aged orchards



# Walnut Blackline Symptoms



- Poor growth & yellowing
- Branch dieback
- Suckering
- Eventual death
- Orchard Longevity:
  - ~ 15-25 years ??



# Walnut Blackline Symptoms

## Black line/canker at union



Black line on 'Paradox'  
(*Juglans hindsii* X *J. regia*)



Black line on black walnut  
(*Juglans hindsii*)



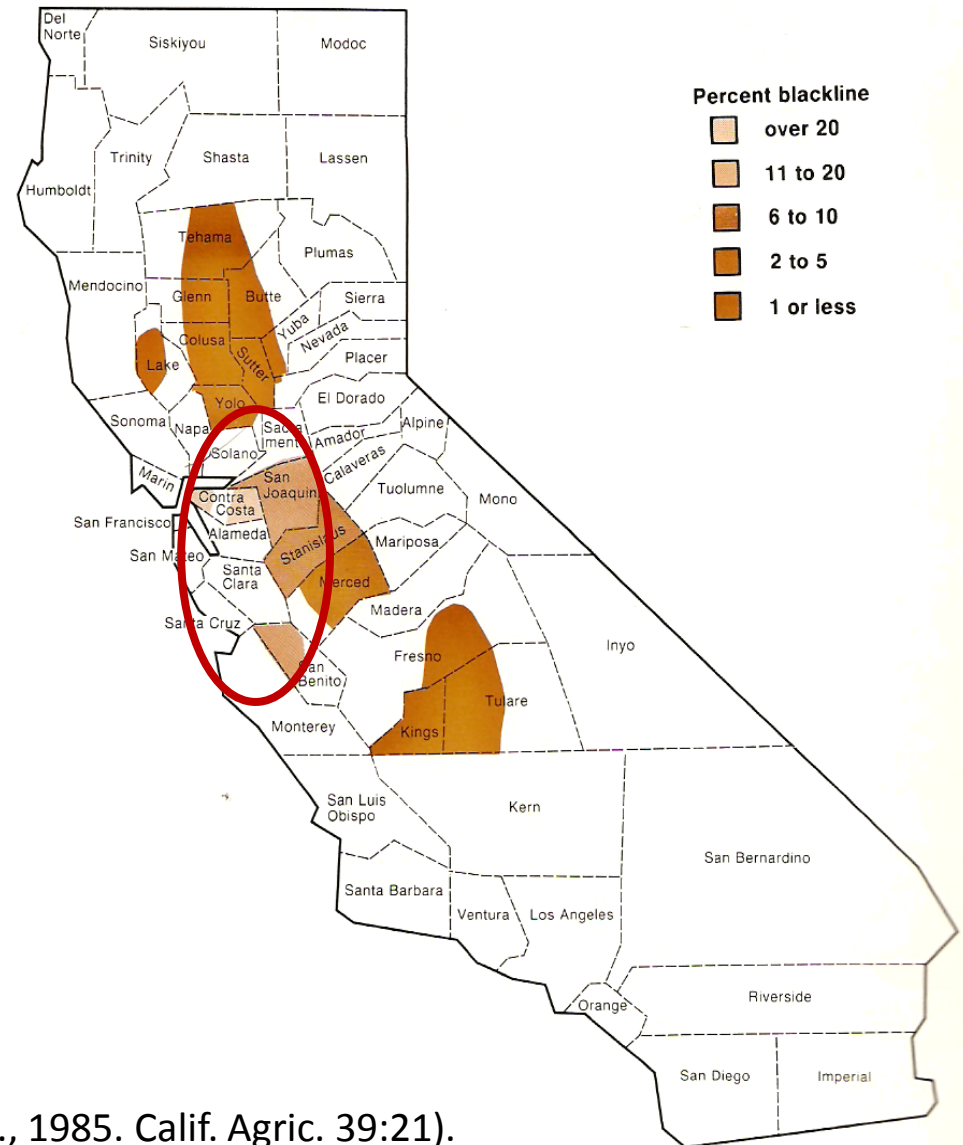
Normal Walnut tree

Photo: M. Sudarshana



# Distribution

County	Blackline Incidence (1982)
Contra Costa	54.0 %
San Joaquin	18.8 %
San Benito	18.3 %
Stanislaus	9.5 %
Merced	3.6 %
Yolo	2.0 %
Yuba	1.1 %



(From: Reil et al., 1985. Calif. Agric. 39:21).

Courtesy of Janet Caprile, FA Emeritus

# Solutions, progress takes time

- Resistant (hypersensitive) Cultivars:

won't let the virus in

- Plant on any rootstock
- Won't spread the disease
- Takes TIME to develop



- Tolerant Rootstocks:

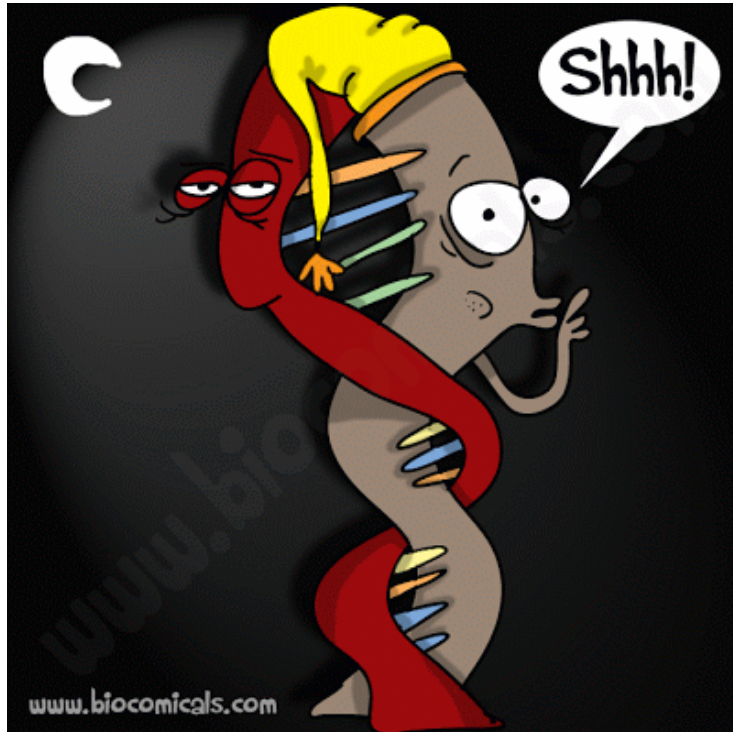
lets the virus in

- Plant any cultivar
- Tree sheds infected pollen & can spread the disease
- Best used in heavily infected areas





# Solutions, progress takes time



RNAi silencing  
CRISPR

# Walnut Rootstock Options

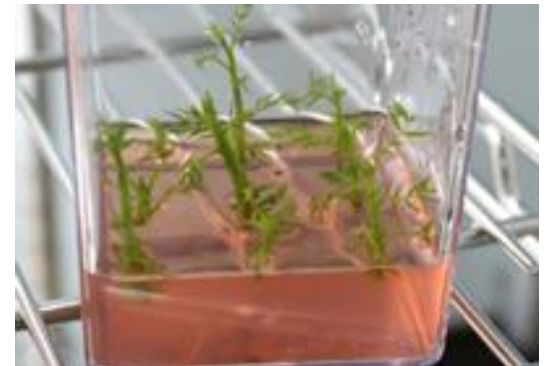
CHARACTERISTICS	ENGLISH		BLACK	PARADOX
	Seedling	Clonal		
Growth/Vigor	ML	MH	M	H
Graftability	L	L	H	H
Salt Tolerance	L	L	H	M
Crown Gall Tolerance	M	H	M	L
Nematode Tolerance	L	L	L	M
Phytophthora Tolerance	L	L	L	M
Armillaria Tolerance	L	L	M	MH
Black Line Tolerance	H	H	L	L

# UCD Walnut Improvement Program

## GOAL:

Develop a better tolerant rootstock than English

- Faster than developing varieties
- Needs to be clonally propagated
- 2005: WIP rootstocks released for field trials



Walnut Improvement Program

<http://walnutrootstock.ucanr.edu/WIP/>

Courtesy of Janet Caprile, FA Emeritus



# COMPARATIVE PERFORMANCE SUMMARY

## 2005-2015

CHARACTERISTIC	ENGLISH Seedling/Clonal	WIP2 clonal	WIP3 clonal	PARADOX Seedling/Clonal
Propagation	L	MH	H	MH/H
Growth/Vigor	L/H	ML	MH	H
Yield Potential	ML/M	M	M	M/MH
Salt Tolerance	L	M	ML	M
Phytophthora Tolerance	L	L	ML	M
Crown Gall Tolerance	M/H	H	H	L/H
WTB/TCD Tolerance	H	H	H	L
Black Line Tolerance	H	H	H	L

# Current Management Options



Photo: Janine Hasey, UCCE  
Farm Advisor Sutter-Yuba

- Tolerant Rootstocks
  - English seedling
  - Own rooted
    - Needs “good” soil
    - Full production at 9 years, not 6
- WIP 3 looks promising
  - Similar size & yields as seedling Paradox
  - Only 10 years of field performance data
  - Only a few years of yield data
- Limited availability



# Questions?

