Pistachio rootstocks

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8th Advances in PISTACHIO PRODUCTION
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What is a rootstock?

The trunk or roots into which the scion material is inserted.

Juncture of rootstock and scion is called the graft union.

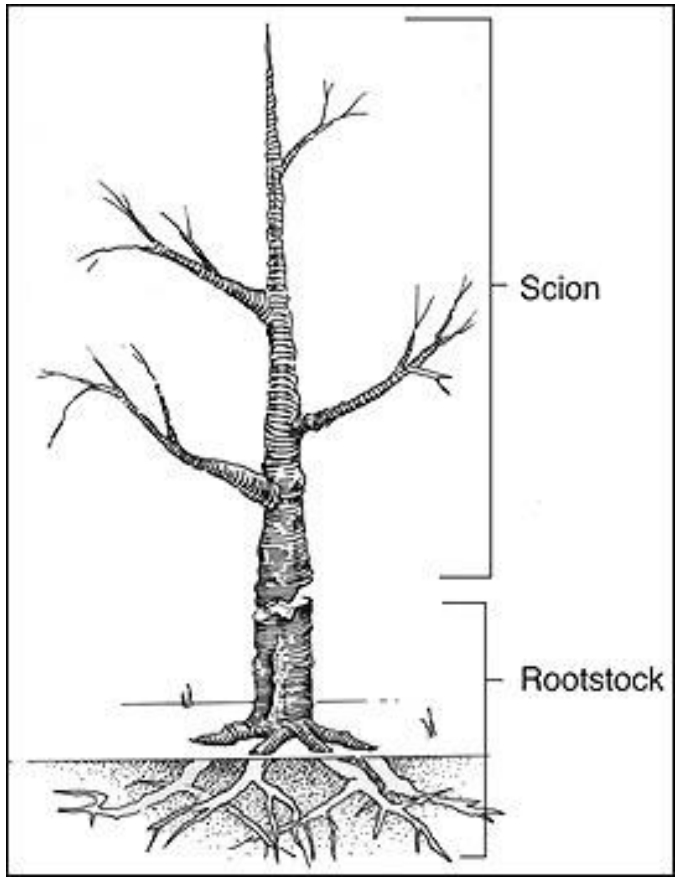


Photo: Ferguson

T- bud is most common method used to bud pistachio scion onto rootstock.

The shield is cut from the budstick and inserted into a T-cut on the rootstock.

Trees planted in Spring are budded in August

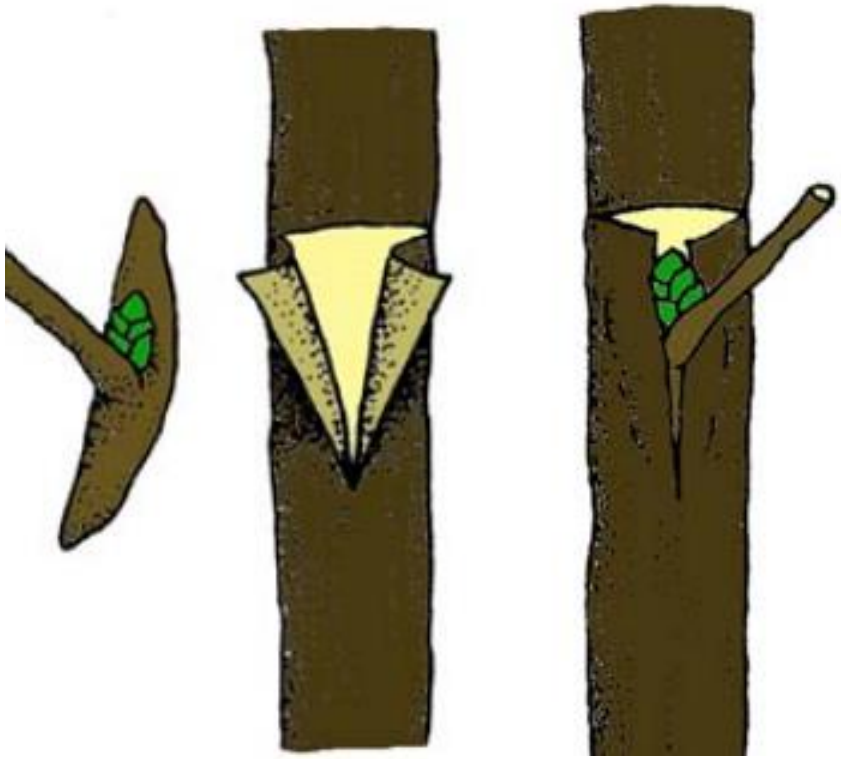


Illustration: aggie-horticlulture.tamu.edu

Why use a rootstock?

- Enhanced freeze tolerance
- Disease or pest tolerance
- Adapted for soil and water quality
- Horticultural properties


Pistachio rootstocks generally
planted in advance of budding

Walnuts are typically budded in the nursery and sold as budded trees


Budded pistachio trees available,
but less common.

Rootstocks and the California Pistachio Industry

Family Anacardiaceae (cashew family)
Genus *Pistacia*
16 Species

Commercial scion:
Pistacia vera

- 14,000 acres planted in Kern County from 1969-1975
- *P. atlantica* and *P. terebinthus* rootstock
- No planting 1975-1980.
- *P. integerrima* seedling rootstock= “new hope and momentum”

Latin ‘*integerrima*’ : incorruptible, sound, unimpaired or having great vitality and force.

The pistachio nut, in the past regarded as a mi
in several Mediterranean and Middle Eastern countries, is becoming a major crop in Kern County and its future here is expected to be even brighter if losses due to Verticillium wilt (a soilborne disease) can be reduced. A rootstock called Pistachia integerrima may well solve the disease problem.

Kern County has approximately 14,000 acres of pistachio trees, planted from 1969 to 1975, with no significant new plantings recorded to date. Most of the plantings are now coming into production. The first significant crop of 12 million pounds was harvested last year. All the indications are that another even better crop will be harvested during the 1980 season.

Many of the county's pistachio plantings are on seedling

because of wilt.

A new hope and momentum is now developing for the pistachio industry in Kern County and other counties in California where the pistachio tree has a possibility to grow and produce.

Several old and new growers are giving serious consideration to new plantings on P. integerrima rootstock.

It is also a linguistic curiosity that the Latin word integerrima, which is a superlative of the word integer, means incorruptible, sound, unimpaired or having great vitality and force.

In any case, the word integerrima well describes the pistachio species resistant to Verticillium wilt.

1980

P. integerrima -- germplasm repository—Winters, CA

Photo: John Preese USDA

Verticillium wilt

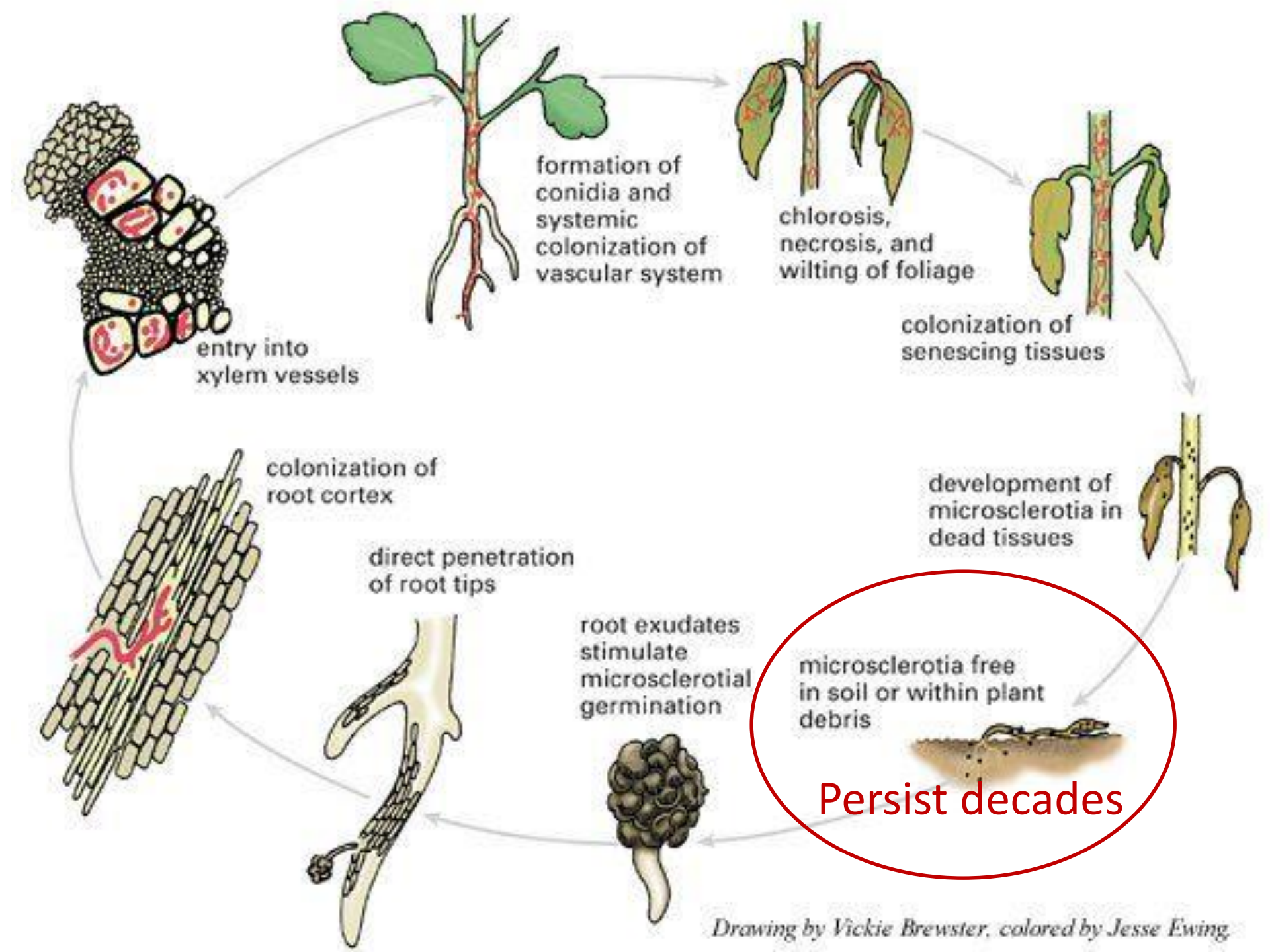
Photo: L. Ferguson

Verticillium wilt

Soilborne fungus*:* *Verticillium dahliae*

Wide host range: over 300 plants

Common crops affected in California include: cotton, solanaceae, cucurbitae, strawberry.


entry into
xylem vessels
formation of
conidia and
systemic
colonization of
vascular system
chlorosis,
necrosis, and
wilting of foliage
colonization of
senescing tissues
development of
microsclerotia in
dead tissues
microsclerotia free
in soil or within plant
debris
Persist decades
root exudates
stimulate
microsclerotial
germination
direct penetration
of root tips
colonization of
root cortex
Drawing by Vickie Brewster, colored by Jesse Ewing

Land-use history affects risk of Vert.

Early Verticillium problems on pistachio were largely associated with cotton.

Microsclerotia/g soil

Virgin land…….. Trace levels

1 year cotton……. <0.5

3 year cotton…….5-8

Tree Mortality (%)

Virgin land…….. 0.4%

1 year cotton……. <0.5%

3 year cotton…….5-8%

Ashworth et al 1976

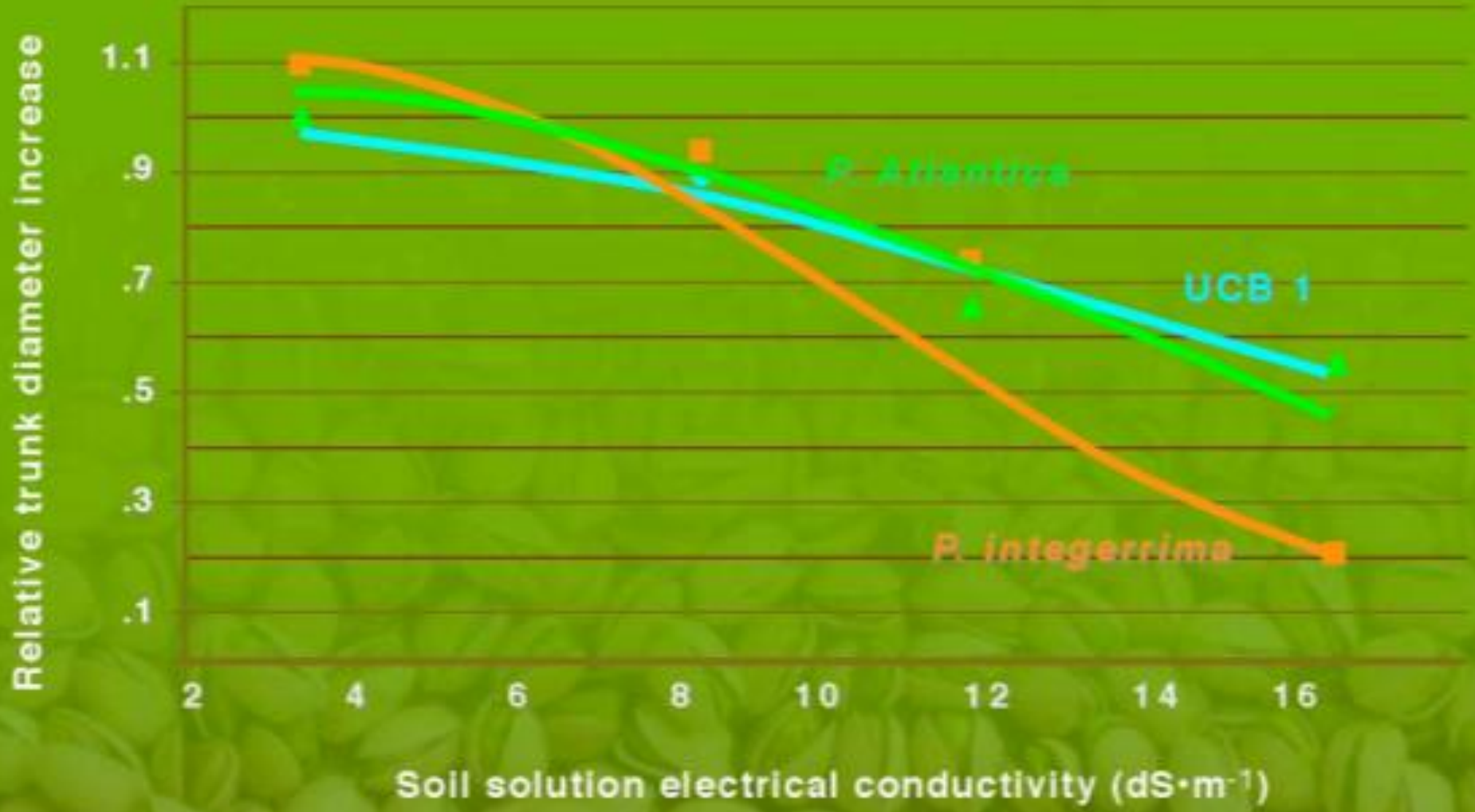
Almond farm calls in late May

Commercial rootstocks in California (1970s to present)

Species		
Rootstock	**Name**	**Characteristic**
P. terebinthus	Terebinthus	Verticillium Susceptible
P. atlantica	Atlantica	Verticillium Susceptible
P. integerrima	PG1	Verticillium Resistant; Frost Sensitive; Seedling

Interspecies hybrids		
P. atlantica 'KAC' x P. integerrima	UCB-1	Verticillium Resistant; Frost Tolerant; Salinity tolerance; Seedling; Clone
P. integerrima x *P. atlantica*	Platinum®	Verticillium resistant selection clonally propagated

Trunk Diameter Increase of 'Kerman' Pistachio as a Function of Increasing Salinity



Slide: L. Ferguson

Pistachio Rootstocks may be propagated sexually (seedlings) or asexually (clones).

Seedling rootstock production


Photo: L. Ferguson


Photo: L. Ferguson

Clonal rootstock production


Photo: NA Plants


Photo: Tissue Grown

Seedling production

Pistacia sp. are dioecious; trees wind pollinated. Controlled crosses necessary

Pollen collected at anthesis

Stored in freezer.

<u>To produce UCB-1 seed</u>:

1. Collect pollen from Integerrima and store.

2. Apply pollen to Atlantica female tree at bloom several weeks later.

Female flowers (Atlantica) are protected for controlled pollination

P. atlantica ‘KAC’ mother

UCB-1 seed resulting from cross

Photo: L. Ferguso

Photo: L. Ferguson

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UCB-1 seedling population Variability and Diversity

Choice rootstocks from seedling populations may be selected for asexual (cloning) propagation.

Selections made for: a) vigor, b) disease resistance, c) compatibility with scions, d) tolerance to soil and water conditions

Pistachio Rootstock Tissue Culture

- Rapid multiplication of plants.

- Axillary bud proliferation employed.

Photo: Tissue Grown

What is micropropagation?

Micropropagation is the practice of rapidly multiplying stock plant material to produce a large number of progeny plants, using plant tissue culture.

Proliferation of Axillary Buds:

- Meristematic-based proliferation system (adventitious systems = higher mutation risk)

- Approximately 5x proliferation per month (more possible, but increases risk of epigenetic variation).

G.C. Phillips and J.F. Hubstenberger, 2013. Micropropagation by Proliferation of Axillary Buds. In: Plant Cell Tissue and Organ Culture, Fundamental Methods, Eds. Gamborg and Phillips, Springer, 2013.

Personal Communication: C. Sluis, Tissue Grown

What is axillary bud proliferation?

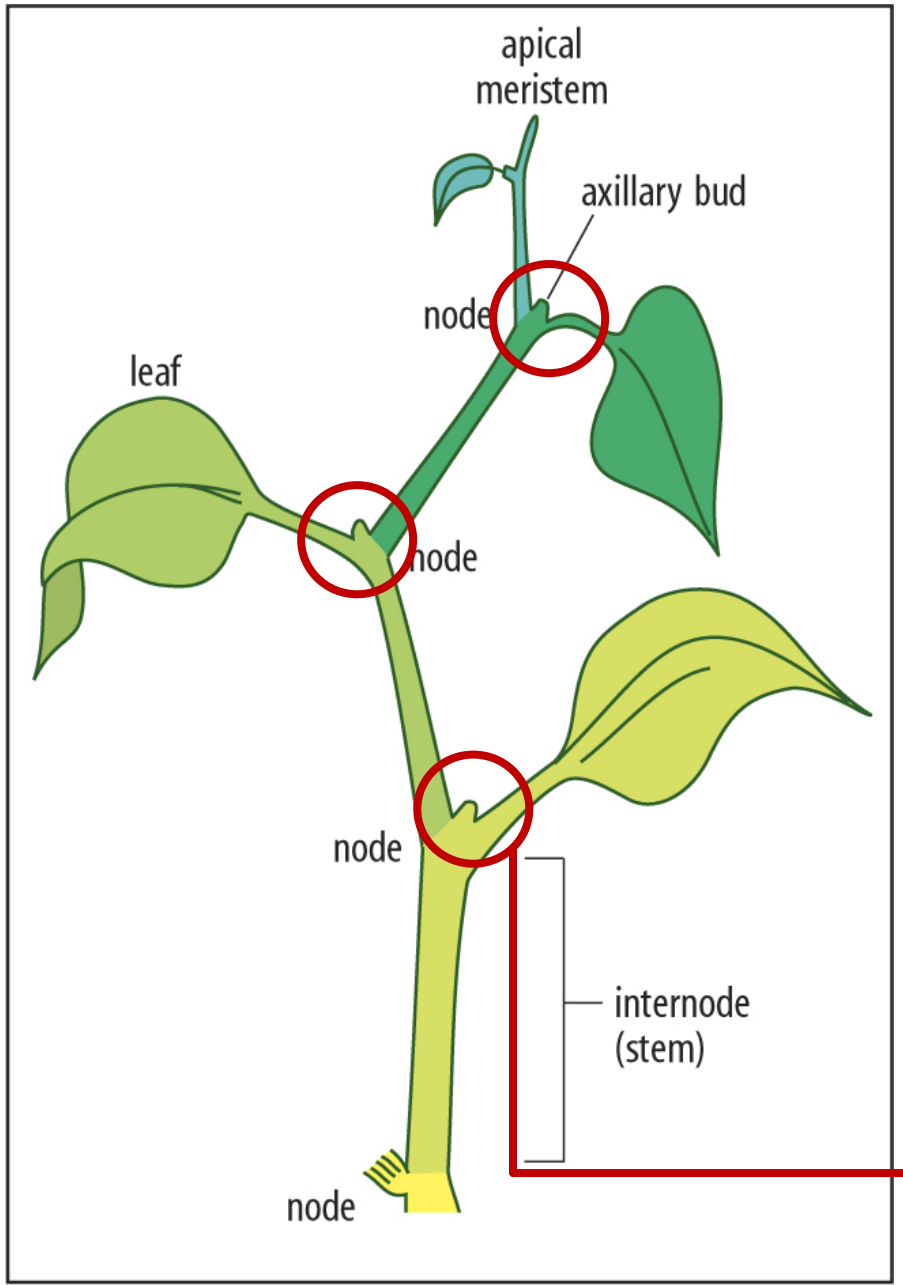


Photo: Tissue Grown

Photo: NA Plants

Photo: NA Plants

Pistachio rootstocks can be asexually propagated:

- ***Tissue culture or cloning***
  - ***Advantage: uniformity***
  - ***Disadvantage: susceptibility***
- ***Uniform susceptibility to pathogens, pests and stresses***

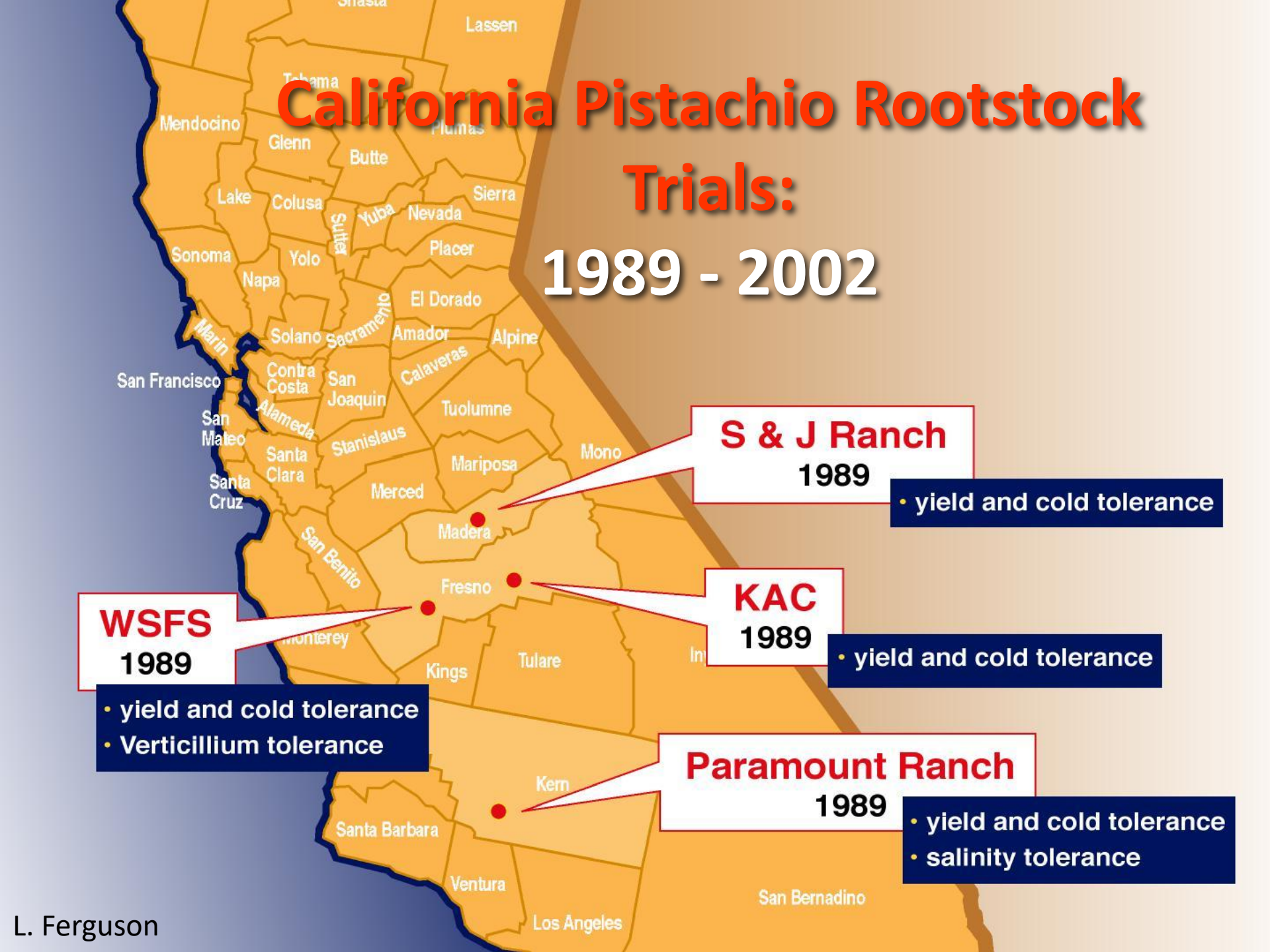
Slide: L. Ferguson

Rootstock Selection

Species		
Rootstock	**Name**	**Characteristic**
P. integerrima	PG1	Verticillium Resistant; Frost Sensitive; Seedling

Interspecies hybrids		
P. atlantica 'KAC' x P. integerrima	UCB-1	Verticillium Resistant; Frost Tolerant; Salinity tolerance; Seedling; Clone
P. integerrima x *P. atlantica*	Platinum®	Verticillium resistant selection clonally propagated

California Pistachio Rootstock Trials: 1989 - 2002



L. Ferguson

San Joaquin Valley Pistachio Rootstock Trials 1989 - 2002

Freeze tolerance

December 1990: 11 nights @ 4-12 F

12/1990: 11 nights @ 4-12* F

Integerrima	41% mortality
Atlantica seedling	No mortality
PG2 seedling	3% mortality
UCB1 seedling	No mortality

* Seedling population; not same as currently utilized Platinum® clone

Cumulative marketable yield from female pistachio trees that survived through 2002 in a trial in *Verticillium dahliae*-infested soil in the SJV

	Tree vigor in 2002			
	Excellent	Good	Fair	Poor
Rootstock	Marketable yield per tree, kg ± Se[z]			
Pistacia integerrima	22 ± 1 a	27 ± 1 a	-	-
UCBI seedling	29 ± 1 b	28 ± 1 a	22 ± 6	9

* Seedling population not same as clonal population currently sold as Platinum®

Epstein et al, 2004

Potential Nematode Problems

Limited data on nematodes on pistachio

Observationally Present, but no symptoms observed:

Lesion (*Pratylenchus vulnus*)
Root knot (*Meloidogyne* sp.)
Stubby root (*Trichodorous* sp.
Ring (*Mesocrichonem*a sp.)

No root knot galls observed on pistachio.

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