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.

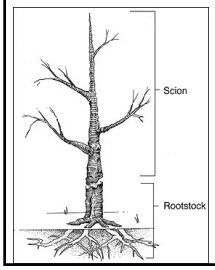


Photo: Ferguson

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

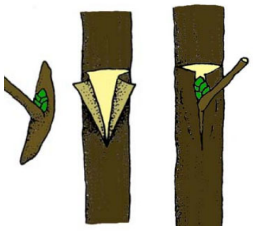


Illustration: aggie-horticulture.tamu.edu

Why use a rootstock?

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

- 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 m
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.

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

Verticillium wilt

Photo: L. Ferguson

Healthy rootstock; dead tree

Scion: *Pistacia vera*

Rootstock*: UCB-1*

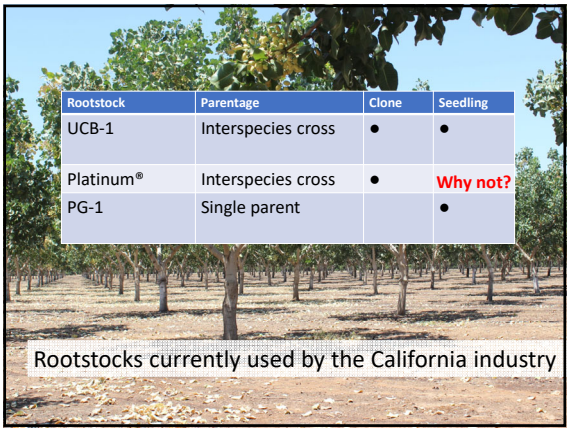
Aerial canker caused by *Phytophthora* introduced by sprinkers.

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


Budded pistachio trees available, but less common.

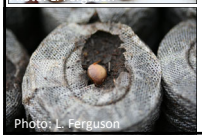
Commercial rootstocks in California (1970s to present)

Species		
Rootstock	**Name**	**Characteristic**
P. terebinthus	Terebinthus	Verticillium Susceptible
P. atlantica	Atlantica	Verticillium Susceptible
P. integerrima	PG1	Verticillium Resistant; Frost Sensitive
Interspecies hybrids		
P. atlantica 'KAC' x P. integerrima	UCB-1	Verticillium Resistant; Frost Tolerant; Salinity tolerance
P. integerrima x *P. atlantica*	Platinum®	Verticillium resistant selection

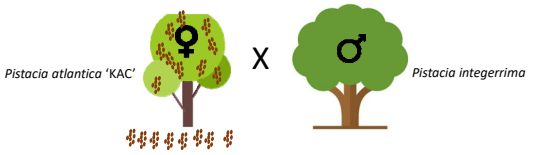


Pistachio Rootstocks may be propagated sexually (seedlings) or asexually (clones).

Seedling rootstock production



Clonal pistachio rootstock production



'UCB-1' Seedling Rootstock

Seedling production

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

17

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

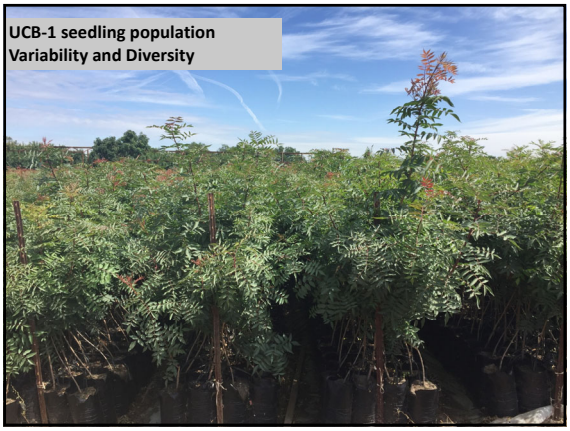
UCB-1 seed resulting from cross


Photo: L. Ferguson


Photo: L. Ferguson


Photo: L. Ferguson

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?

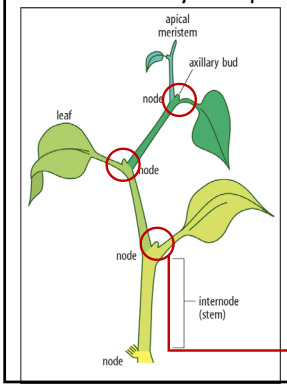
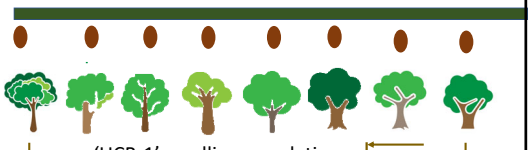


Photo: Tissue Grown

Where do the clones come from?



'UCB-1' seedling population

Nursery/Lab A (Clonal UCB-1)

Variability between clonal lines of UCB-1

Uniformity within clonal lines of UCB-1

Nursery/Lab B (Clonal UCB-1)

Nursery/Lab C (Clonal UCB-1)

Why do these clonal lines all have the same name (UCB-1)?

Nursery/Lab A (UCB-1)

Nursery/Lab B (UCB-1)

Nursery/Lab C (UCB-1)

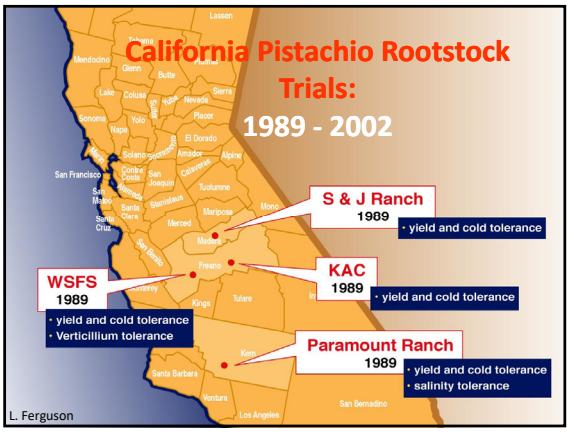
Northern CA Black (*J. hindsii*) ♀

English Walnut (*J. regia*) ♂

'Paradox'

'VX211'

'Vlach'



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

32

Cold Tolerance

Atlantica parentage associated with cold tolerance

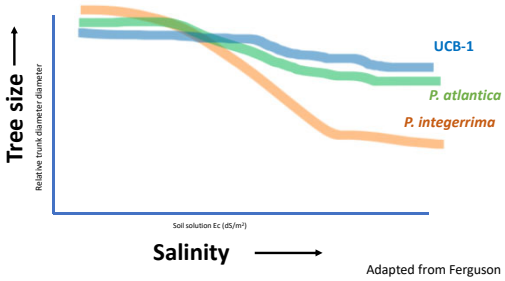
- UCB-1
- Platinum

West Side Field Station: new trial planted in 2019
(Culumber and Lampinen)

- UCB-1 and Platinum rootstocks
- Influence of last irrigation date on cold tolerance

Salinity

Trunk diameter increase of 'Kerman' pistachio as a function of increasing salinity



Adapted from Ferguson

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 ± Se²			
Pistacia integerrima	22 ± 1 a	27 ± 1 a	-	-
P. atlantica	23 ± 3 ab	29 ± 1 a	16 ± 1	9 ± 2
PGII *seedling population	28 ± 4 ab	24 ± 2 a	15 ± 1	9 ± 1
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