Pistachio rootstocks

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Farm Advisor: nuts, prunes, olives
UCCE Tulare and Kings Counties
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.
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.
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

- *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 minor crop 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 in media 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.
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.
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)

<table>
<thead>
<tr>
<th>Species</th>
<th>Rootstock</th>
<th>Name</th>
<th>Characteristic</th>
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<tr>
<td></td>
<td><em>P. terebinthus</em></td>
<td>Terebinthus</td>
<td>Verticillium Susceptible</td>
</tr>
<tr>
<td></td>
<td><em>P. atlantica</em></td>
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<td>Verticillium Susceptible</td>
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<td></td>
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<td>Verticillium Resistant; Frost Sensitive; Seedling</td>
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### Interspecies hybrids

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<td>Verticillium Resistant; Frost Tolerant; Salinity tolerance; Seedling; Clone</td>
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<tr>
<td><em>P. integerrima x P. atlantica</em></td>
<td>Platinum®</td>
<td>Verticillium resistant selection clonally propagated</td>
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Trunk Diameter Increase of ‘Kerman’ Pistachio as a Function of Increasing Salinity

Relative trunk diameter increase vs. soil solution electrical conductivity (dS·m⁻¹)

- P. Atlantica
- UCB 1
- P. integerrima

Slide: L. Ferguson
Pistachio Rootstocks may be propagated sexually (seedlings) or asexually (clones).

**Seedling** rootstock production

![Seedling rootstock](Photo: L. Ferguson)

**Clonal** rootstock production

![Clonal rootstock](Photo: NA Plants)  
![Clonal rootstock](Photo: Tissue Grown)
Seedling production

*Pistacia* sp. are dioecious; trees wind pollinated. Controlled crosses necessary.
Pollen collected at anthesis
Stored in freezer.

To produce UCB-1 seed:

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
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.
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).


Personal Communication: C. Sluis, Tissue Grown
What is axillary bud proliferation?
Pistachio rootstocks can be asexually propagated:

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

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- **WSFS 1989**
  - yield and cold tolerance
  - Verticillium tolerance

- **S & J Ranch 1989**
  - yield and cold tolerance

- **KAC 1989**
  - yield and cold tolerance

- **Paramount Ranch 1989**
  - yield and cold tolerance
  - salinity tolerance

L. Ferguson
## Freeze tolerance

December 1990: 11 nights @ 4-12°F

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<th>Seedling Type</th>
<th>Mortality</th>
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<td>UCB1 seedling</td>
<td>No mortality</td>
</tr>
<tr>
<td>PG2 seedling</td>
<td>3% mortality</td>
</tr>
<tr>
<td>Atlantica seedling</td>
<td>No mortality</td>
</tr>
<tr>
<td>Integerrima</td>
<td>41% mortality</td>
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* 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

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<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<tr>
<td><em>Pistacia integerrima</em></td>
<td>22 ± 1 a</td>
<td>27 ± 1 a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>UCBI seedling</td>
<td>29 ± 1 b</td>
<td>28 ± 1 a</td>
<td>22 ± 6</td>
<td>9</td>
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* Seedling population not same as clonal population currently sold as Platinum®
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 (*Mesocrichonema* sp.)

No root knot galls observed on pistachio.
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