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

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.

Verticillium wilt

Photo: L. Ferguson
Healthy rootstock; dead tree

Scion: Pistacia vera   Rootstock: UCB-1

Aerial canker caused by Phytophthora introduced by sprinkers.

Pistachio rootstocks generally planted in advance of budding
Walnuts are typically budded in the nursery and sold as budded trees. Budded pistachio trees are available, but less common.
Commercial rootstocks in California (1970s to present)

<table>
<thead>
<tr>
<th>Species</th>
<th>Rootstock</th>
<th>Name</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. terebinthus</td>
<td>Terebinthus</td>
<td>Verticillium Susceptible</td>
<td></td>
</tr>
<tr>
<td>P. atlantica</td>
<td>Atlantica</td>
<td>Verticillium Susceptible</td>
<td></td>
</tr>
<tr>
<td>P. integerrima</td>
<td>PG1</td>
<td>Verticillium Resistant; Frost Sensitive</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interspecies hybrids</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. atlantica 'KAC' x P. integerrima</td>
</tr>
<tr>
<td>UCB-1</td>
</tr>
<tr>
<td>Verticillium Resistant; Frost Tolerant; Salinity tolerance</td>
</tr>
<tr>
<td>P. integerrima x P. atlantica</td>
</tr>
<tr>
<td>Platinum®</td>
</tr>
<tr>
<td>Verticillium resistant selection</td>
</tr>
</tbody>
</table>

Rootstocks currently used by the California industry

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Parentage</th>
<th>Clone</th>
<th>Seedling</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCB-1</td>
<td>Interspecies cross</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Platinum®</td>
<td>Interspecies cross</td>
<td>●</td>
<td>Why not?</td>
</tr>
<tr>
<td>PG-1</td>
<td>Single parent</td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

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

Seedling rootstock production

Clonal pistachio rootstock production
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.

Photo: L. Fergus
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).
What is axillary bud proliferation?

Where do the clones come from?

Why do these clonal lines all have the same name (UCB-1)?
San Joaquin Valley
Pistachio Rootstock Trials
1989 - 2002

Freeze tolerance
December 1990: 11 nights @ 4-12 F
12/1990: 11 nights @ 4-12* F

<table>
<thead>
<tr>
<th>Seedling Population</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integerrima</td>
<td>41%</td>
</tr>
<tr>
<td>Atlantica</td>
<td>No mortality</td>
</tr>
<tr>
<td>PG2</td>
<td>3% mortality</td>
</tr>
<tr>
<td>UCB1</td>
<td>No mortality</td>
</tr>
</tbody>
</table>

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

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

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

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Tree vigor in 2002</th>
<th>Marketable yield per tree, kg ± Se*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Excellent</strong></td>
<td><strong>Good</strong></td>
<td><strong>Fair</strong></td>
</tr>
<tr>
<td><em>Pistacia integerrima</em></td>
<td>22 ± 1 a</td>
<td>27 ± 1 a</td>
</tr>
<tr>
<td><em>P. atlantica</em></td>
<td>23 ± 3 ab</td>
<td>29 ± 1 a</td>
</tr>
<tr>
<td>PG1 seedling population</td>
<td>28 ± 4 ab</td>
<td>24 ± 2 a</td>
</tr>
<tr>
<td>UCB seedling</td>
<td>29 ± 1 b</td>
<td>28 ± 1 a</td>
</tr>
</tbody>
</table>

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

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**Rootstocks Demystified**