Walnut Rootstock Selection

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Walnut Rootstocks in California

Desired attributes

- Vigor (= Productivity)
- Tolerant to pests and diseases, especially:
  - Phytophthora root and crown rot
  - Lesion nematode (*Pratylenchus vulnus*)
  - Crown gall (*Agrobacterium*)
  - Walnut blackline disease (Cherry leaf roll virus)
  - Oak root fungus (*Armillaria mellea*)
Walnut rootstocks: “Three” choices

Northern California Black Walnut
Paradox hybrid - seedlings and clones
English walnut – seedlings and own-rooted
Northern California Black
(J. hindsii)
Northern California Black
*(J. hindsii)*

Moderate vigor, less than Paradox seedlings or clones

Susceptible to blackline

More susceptible to Phytophthora than Paradox seedlings or clones

**Most tolerant of available rootstocks to salts**

Some resistance to crown gall

May be less susceptible to Armillaria depending on situation
Paradox Rootstock

**Hybrid of English walnut by:**

*J. hindsii* (Northern California Black Walnut)

Or hybrids of *J. hindsii* and:

- *J. californica*
- *J. major*
- *J. nigra*
- *J. microcarpa*
Paradox seedlings

Vigorous

Susceptible to blackline

Less susceptible to Phytophthora than Black or English

Parentage variable, as is vigor and soil-borne disease susceptibility

Susceptible to crown gall

Intermediate in salt sensitivity between Black and English
### UC Paradox Diversity Study

**LARGEST trunk circumference - all sites at end of 10\textsuperscript{th} year**

<table>
<thead>
<tr>
<th>Source</th>
<th>Parentage</th>
<th>circ (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLACH</td>
<td>JhxJr</td>
<td>67.2</td>
</tr>
<tr>
<td>OX</td>
<td>JhxJr</td>
<td>66.8</td>
</tr>
<tr>
<td>DX</td>
<td>JhxJr</td>
<td>66.8</td>
</tr>
<tr>
<td>PZ</td>
<td>JhxJr</td>
<td>66.6</td>
</tr>
<tr>
<td>LZ</td>
<td>?</td>
<td>66.1</td>
</tr>
<tr>
<td>RZ</td>
<td>JhxJr</td>
<td>66.1</td>
</tr>
<tr>
<td>LX</td>
<td>JhxJnJxJr</td>
<td>66.1</td>
</tr>
<tr>
<td>UZ</td>
<td>JhxJr</td>
<td>65.9</td>
</tr>
<tr>
<td>SZ</td>
<td>JhxJr</td>
<td>65.9</td>
</tr>
<tr>
<td>KX</td>
<td>JhxJr</td>
<td>65.7</td>
</tr>
</tbody>
</table>

- **Blue** = in TOP TEN at two sites
- **Yellow** = in TOP TEN at three sites

Jh = *Juglans hindsii*  
Jr = *Juglans regia*  
Jm = *Juglans major*  
Jn = *Juglans nigra*  
Jc = *Juglans californica*
**UC Paradox Diversity Study**

**SMALLEST** trunk circumference - all sites at end of 10\(^{th}\) year

<table>
<thead>
<tr>
<th>Source</th>
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<th>Circ (cm)</th>
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<tr>
<td>OZ</td>
<td>JhxJnxJr</td>
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<tr>
<td>YZ bl</td>
<td>JnxJh</td>
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<tr>
<td>JX</td>
<td>JhxJr</td>
<td>59.51</td>
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<td>QZ</td>
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<td>NZ</td>
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<td>57.07</td>
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<td>AZ</td>
<td>JmxJnxJhxJr</td>
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<tr>
<td>BX bl</td>
<td>JcxJn</td>
<td>55.24</td>
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<tr>
<td>AW bl</td>
<td>Jh</td>
<td>50.94</td>
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</table>

\(Jh = \text{Juglans hindsii}\)

\(Jr = \text{Juglans regia}\)

\(Jm = \text{Juglans major}\)

\(Jn = \text{Juglans nigra}\)

\(Jc = \text{Juglans californica}\)
Clonal Paradox Rootstocks

Hybrids:  *J. hindsii* or *J. microcarpa* × *J. regia*

- **Vlach** - Unpatented
- **RX1** - Patented and licensed to nurseries
- **VX211** - Patented and licensed to nurseries
- **(WIP3 – Not released)**
Clonal Paradox Rootstocks

**VLACH** (*J. hindsii* X *J. regia*)

- First clone to be commercialized
- Vigorous
- Susceptible to blackline
- Phytophthora, root lesion nematode, and crown gall susceptibility similar to Paradox seedlings
Clonal Paradox Rootstocks

**VX211** (*J. hindsii* X *J. regia*)

Highly vigorous

Susceptible to blackline

Phytophthora susceptibility similar to Paradox seedlings

Some tolerance to root knot and root lesion nematode

Susceptible to crown gall
Clonal Paradox Rootstocks

RX1 \((J. \text{hindsii} \times J. \text{micrpcarpa})\)

Moderate to high vigor depending on site
Susceptible to blackline
Moderately to highly resistant to Phytophthora, depending on species present
Susceptible to root lesion nematode
Paradox Clones vs. Seedlings?

Lacking known problems, from experience to date, clones appear to grow and produce at least as well as – and occasionally better than - seedlings.

Their primary advantages are in their respective pest & disease tolerance.

More clonal rootstocks – from UC and others – are coming.
English Walnut Rootstocks 
(*J. regia*)

- Seedlings of *J. regia* varieties 
  (Eureka, Waterloo, Vina, others)
- Tissue cultured “Own-rooted” varieties

Blackline disease 
(Cherry Leaf Roll Virus)

*J. hindsii* black Paradox
Trunk Cross Sectional Area
Chandler on English SEEDLING rootstocks

12’ X 24’ hedgerow planted 1994, Linden, California

Graph showing the trunk cross sectional area (cm²) of different rootstocks from 1995 to 2003. The rootstocks include Eureka, Carpathian, Paradox, Russian, Sunland, Waterloo, and Chandler. The graph indicates that Paradox has the largest trunk cross sectional area over the years, followed by English.
Cumulative yield
Chandler on English SEEDLING rootstocks
12’ X 24’ hedgerow planted 1994, Linden, California
English Walnut Rootstocks

Own-Rooted Chandler

More vigor than English seedlings but often less than Paradox –
Best on medium-textured soils

Less susceptible to crown gall than Paradox; More susceptible than Paradox to other soil-borne diseases

Slow to begin producing catkins during early years

Bloom, pollen shedding, and harvest slightly delayed

Low early orchard production in some instances

Sensitive to salts

OR

Paradox
San Joaquin County Rootstock Trial
Cumulative yield, 4th - 8th leaf

Cumulative yield mean separation by Duncan's Multiple Range test, P< 0.05
Preferred rootstocks for problem situations

“Pick your poison....”

**No known problems**: Seedlings, or Vlach, VX211 for more vigor

**Blackline**: Own-rooted, English seedlings

**Phytophthora**: RX1

**Nematodes**: VX211

**Salts**: Black, Paradox seedlings or clones
Too much of a good thing . . . ??!!

Potted Vlach planted Spring 2013, budded Fall 2013

Laterals emerging from developing trunk in first year

Chandler on Vlach, Stanislaus County

Tulare on Vlach, San Joaquin County
Too much of a good thing . . . ??!!

Buds produced on very rapidly growing trees may be blind or fail to emerge, leading to tree training difficulties

Unheaded Tulare on Paradox Seedling

Tulare field budded onto very vigorous Paradox seedling rootstock in late summer 2013; Unheaded in Winter 2014

Winter 2015