ALMOND ROOTSTOCKS OVERVIEW

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- Rootstock used
- Plant material
- Soil Types

- Breeding needs
- Planting system and Recent trials
Almond Rootstock AUSTRALIA

- Nemaguard: 92%
- Brights Hybrid®: 3%
- GF-677: 4%
- Others: 1%

*Courtesy of ABA (Australia), 2014*
Almond Rootstock USA

Rootstock used

- Krymsk® 86: 5%
- Viking TM: 10%
- AxP Hybrids: 15%
- Others Plums Hybrids: 5%
- Peach seedling: 65%

Reighard, G. 2015
Almond Rootstock SPAIN

- GF-677: 43%
- Others: 1%
- Rootpac® 20: 9%
- Garnem: 20%
- Almond Seedling: 25%
- Replant-R: 2%

Rootstock used

Rubio-Cabetas, M.J. 2015
ROOTSTOCK vs SCION

- Easy of propagation and budding
- Clonal uniformity
- Compatibility with various scions
- Upright growth habit and longevity
- Nutritional efficiency under various pH and textural classes
- Precocity and fruit quality to scion
- Freedom from latent or expressed viruses
- Size control for different training systems and orchard designs
- Pest and disease resistance (or at least tolerance)
- Soil and climate adaptability
BIOTIC STRESS

NEMATODES:
- Root-Knot (*Meloidogyne* spp.)
- Ring (*Mesocrinema xenoplax*)
- Peach Tree Short Life
- Lesion (*Pratylenchus*)

FUNGI:
- *Armillaria* ARR
- *Rosellinia*

BACTERIA
- *Pseudomonas*
- *Agrobacterium*
- CAPNODE
- *Capnode*

More progress in inoculation methodology is needed!!!
ABIOTIC STRESS

Root Physiology

- Waterlogging
- Chlorosis
- Salinity
- Drought

More progress in evaluation methodology is also needed!!
## Almond Rootstock: 1995-2000

<table>
<thead>
<tr>
<th>YEAR</th>
<th>ROOTSTOCK</th>
<th>COUNTRY</th>
<th>Genetic origin</th>
<th>Main objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>Viking-Atlas</td>
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</table>
Plant material

- **Seedlings: Arid Soils**
  - Almond
  - Peaches
    - Controler® 6

- **Interespecífic hybrids: Alkaline soils**
  - GF–677
  - Bright’s
  - Cornestone
  - Garnem
  - Felinem
  - Monegro
  - Control Vigor:
    - R–20

- **Plum: Heavy soils**
  - Montizo
  - PS101
  - Marianna 2624
  - Krymsk ® 86
# Soil Types

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<th>Type of crop:</th>
<th>ROOTSTOCKS</th>
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<tr>
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<td>Deep and aerated soils</td>
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<td>Strong or loam soils</td>
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<td>Clay soils</td>
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- XXX, XX, X = best 🍊, good 😞, and least desirable 😞 rootstock option

*Rubio-Cabetas and Felipe 2010*
Root-Scion Interaction and Tree Physiology

- Agronomical Performance
  - Graft-Compatibility
  - Vigor
  - Replanting
**GRAFT-In-COMPATIBILITY**

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<th>GRAFT COMPATIBILITY</th>
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</table>

XXX, XX, X = best 🙆‍♂️, good 😞 and least desirable 😞. Not a stock option.

*Rubio-Cabetas and Felipe 2010*
VIGOUR CONTROL

GF677  P.S. A6  P.S. B2  Rubirà  P.S. A5

Vigor respecto a Garnem®

R-20  R-40  R-70  GF-677  Garnem
Irrigation 1970’s

GF - 677 -- Peach Seedling -- Almond Seedling
Irrigation 2015’s

R-70  R-40  R-90  Replant  Garnem
Recent Trials

BREEDING

ROOTSTOCK

USED

ROOTSTOCKS

PLANT MATERIAL

SOIL TYPE

GRAFT

COMPATIBILITY

PLANTING SYSTEM

REPLANTING

VIGOUR

SCION

UNION

ROOTSTOCK

Recent Trials
Planting System

- TRADITIONAL
  - 7x6m
  - 6x6m
  - 6x5m
Planting System

- SEMI INTENSIVE
  - 6x5m
  - 5x5m
  - 5x4m
Planting System

- Super High Density
  - 4x1.5m
  - 4x1m
  - 3.5x1m
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<td>Rootpac R</td>
<td>Nemaguard</td>
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*Training System
** Graft Compatibility
RECENT TRIALS

- SPAIN
- ARAGON
- CATALUÑA
- MURCIA
- ANDALUCIA

- AUSTRALIA
- CALIFORNIA
ARAGON-2010

CITA Varieties
*Soleta and Belona/ Rootpac-20 y Rootpac-40

• 3.5m and 1.0-1.5m respectively (2,222 to 2,857 trees/ha)

*No central leader.

*Mechanically harvest with wine Harvested

Yield target of 2,000 to 2,500kg/ha.
ARAGON-2010

Soleta (CITA)/GARNEM

- SEMI INTENSIVE
  6x6m

* No central leader
* Summer pruning
* Mechanically harvest with Tenias

- Yield target of 3,000kg/ha.
ARAGON-2011

Semi-Intensive: **4x2m**
- *Graft-Compatibility*
  - **R-20:**
  - *Central Axe*

- **Citra:**

- **9 x Lauranne/R-20**
- **9 x Guara/R-20**
*Three management systems were under trial using Rootpac-40:

1. Central leader – Row and tree spacing’s were **4m and 1.5m**
2. Hedge – Row and tree spacing’s were **4m and 2m**
3. *Minimal hedge / prune – Row and tree spacing’s were **4m and 2m**
ARAGON-2013

SHD: 3x1m

CITA Varieties

- Lauranne/Garnem
- Soleta/R-20/R-40/RR
- Belona/R-20/R-40/RR
- Guara/R-20/R-40/RR/R-90/R-70/Garnem/GF-677
ARAGON-2014

- Guara/Garnem
  Soleta/R-70
  Soleta/Garnem
  Soleta/GF-677

SHD
4x1,5m
3,5x1m
3,5x1,5m
3,5x1m
CATALONIA-2009

IRTA Varieties

Vayro and Marinada/ GF-677

Semi-Intensive:

- 6X6
- 5.5X3.5
- 5X3
- 4.5X3
- 5X2

*This was the first HD trial
Six training systems were investigated
CATALONIA-2010

- Semi-Intensive
- 5 x 4m

IRTA Varieties
- Garnem
- Cadaman
- GF-677
- Replant-R
- (PxA) x Myrobalan
- Puebla de soto
- Rootpac-40
- MB 1-37
- Isthara
- Rootpac-20

Catalonia
*This was the second HD

This trial investigated three training systems based on the outcomes from the first trial:

* Minimal vase
* Single leader
* Hedge

IRTA Varieties

Vayro y Marinada/ MB-1-37

Semi-Intensive

6m x 2.8m
5m x 1.6m
5m x 1.6m
MURCIA-2010

- Traditional: 6x7

CITA and CEBAS Varieties
Belona
Guara
Antoñeta
Marta
Largueta
Ramillete

/GF-677
/GARNEM
/GARRIGUES
AUSTRALIA-2013

= Nonpareil (non-pollinator)
= Carmel (pollinator)
= Peerless (pollinator)
= monitored trees

7,30 x 4,00 m

1. Nemaguard
   GF-557
   GF-677
   GF-749
   Adafuel
   Garnem
   Felinem
   Monegro
   Brights #5
   Hansen
   Cornerstone
   Nickels
   Krymsk 86
   Penta
   Tetra
1. Lovell
2. Nemaguard
3. Empyrean 1
4. Avimag-Cadaman
5. HBOK 50
6. Hansen
7. Brights #5
8. BB 106
9. Paramount: GF-677
10. Flordaguard x Alnem
11. R-20
12. HM2+
13. Viking
14. Atlas
15. Krymsk 86
16. Rootpac R
1. Nursery Characteristics

Seedlings with high germination rates
Homogeneous plants
Cuttings:
- Easy and unexpensive cutting production
- Easy rooting and strong root system
Nursery behaviour:
- Erect growth habit with few feathers at the budding point

2. Graft Compatibility

Compatibility with all or most cultivars

3. Orchard Characteristics

High transplant rate
Homogeneous development
Induced size adequate to the growing conditions
High precocity and productivity
High water and nutrient efficiency
Good anchorage
Low sucker production

4. Resistance to Biotic/Abiotic Stress

Good adaptation to problematic soils (heavy and/or calcareous soils,...)
Resistance to adverse conditions:
- Drought
- Root and crown asphyxia
Resistance to soil pathogens:
- Nematodes
- Insects (Capnodia, etc.)
- Bacteria (Agrobacterium)
- Fungi (Verticillium, Armillaria, etc.)

5. Good Sanitary status

Free from known viruses
To move fast to give answers to Modern Almond Growers!
*Rootstock choice should be site specific and based on the physical, biological conditions in your field and of Training System-Harvesting

*Think about what specific challenges your ground may have and select the appropriate rootstock

*Don’t ignore the bottom half of the tree! The best offense is a good defense

Thanks for your attention!!!
Merci pour votre attention!

M.J. Rubio-Cabeta
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