Apple Orchard Management

Joseph Grant
University of California Cooperative Extension
jagrant@ucdavis.edu

Iraq Agricultural Extension Revitalization Project
Training Conference
15-25 May 2010 Erbil, Iraq
Apple Orchard Management

• Site Selection & preparation
• Varieties
• Rootstocks
• Tree Spacing
• Cultural Practices
  – Orchard systems, training and pruning
  – Fruit thinning
  – Fertility (tree nutrition)
  – Weed control
  – Irrigation
• Pests and other disorders
Apple Site Selection

- Enough winter chilling
- No spring frost and good air drainage
- Good Soil (drainage, fertility)
- Less rain in spring and summer = less disease
- Good water (supply and Quality)
Soil for apples

Rooting Depth (1- 1.5 meters)
Water holding capacity
Uniformity
Drainage
pH, Fertility
Land Preparation

- Improve drainage
- Adjust pH
- Control weeds
- Tree layout
The BEST Variety

• Plant varieties that people will buy, and
  – give good fruit size, good color, keeping quality, disease resistance, and good flavor IN YOUR CONDITIONS
Traditional Varieties

- Golden Delicious
- Red Delicious
- Fuji
- Gala
- Granny Smith
- Yellow Newtown
- Rome Beauty
- Gravenstein
New Specialty Varieties

- Braeburn
- Pink Lady
- Jonagold
- Pink Pearl
- Pacific Rose
- Tsugaru
- Arlet
- Cameo
- Empire
- Ginger Gold
- Golden Supreme
- Honeycrisp
- Kinsei
- Orin
- Pinova
- Ambrosia
Antique Varieties

- Jonathan
- Sierra Beauty
- Arkansas Black
- Northern Spy
- Spitzenburg
- MacIntosh
Almost all apples require cross-pollination

- Unable to set a commercial crop with their own pollen
- **Bees** transfer pollen from one variety to another
- Need multiple varieties (or crabapple pollenizers) blooming at same time
Honeybee pollination

- 2 to 4 hives per hectare
- Temperatures $\geq 14^\circ C$
- No Rain
- Wind $< 24$ kph
### Pollenizer arrangements

<table>
<thead>
<tr>
<th>A</th>
<th>A</th>
<th>B</th>
<th>B</th>
<th>A</th>
<th>A</th>
<th>B</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>C</th>
<th>A</th>
<th>C</th>
<th>A</th>
<th>A</th>
<th>C</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>C</th>
<th>A</th>
<th>C</th>
<th>A</th>
<th>A</th>
<th>C</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>C</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>A</th>
<th>B</th>
<th>B</th>
<th>B</th>
<th>B</th>
<th>A</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>C</th>
<th>A</th>
<th>C</th>
<th>A</th>
<th>A</th>
<th>C</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

A = 'Granny Smith'
B = 'Fuji'
C = Crabapple pollenizer (Not harvested)
Apple Rootstocks

- Tree size
- Vigor
- Precocity
- Fruit size and quality
- Cold tolerance
- Root suckers
Apple Rootstocks

- Seedling
- Clonal
  - M-111
  - M-106
  - M-7a
  - M-26
  - M-9
  - B-9
  - Mark
  - EMLA Series
  - Others
Apple Orchard Systems

- High or low density
- Complex or simple
  - Cost to establish
  - Trellis or free-standing
  - Early return on investment
  - Horticultural skill required
  - Rootstock and nursery tree availability
  - Variety
    - Vigor
    - Growth habit, Fruit bearing habit
    - Importance of red color
- Labor cost & availability (pruning, harvest)
High density – dwarfing rootstock – full bearing 4th year – easy to thin and harvest

Low density – seedling rootstock – less color – full bearing 10th year – hard to thin and harvest
Correct Spacing

• Rootstock
• Variety
• Site

\[
\{ \text{Rootstock}, \text{Variety}, \text{Site} \} = \text{“System”}
\]

• Tree Height = \(\frac{3}{4}\) the Row Spacing

What will tree size be??????
Trees too large for spacing
Apple Tree Training Systems

High density

- **Pyramid**
- **Central Leader** - Slender Spindle - Vertical Axe - Monocone
- **Espalier** - ‘Y’ - ‘U’ - Parallel ‘Y’ - Perpendicular ‘Y’
- **Lincoln Canopy**
- **Tatura** - ‘V’

Low density

- **Vase** - Open Center
- **Central Leader**
Slender Spindle
Tatura
Light Management

- More Fruit Color
- Strong buds
- Strong Flowers
- Larger Fruit
Pruning apples

• **Young trees:**
  • To develop tree shape and structure

• **Mature trees:**
  • Balance Growth & Fruiting
  • Get Light Low in the Tree
  • Thin Crop
  • Remove Suckers & Water Sprouts
  • Invigorate or Stunt (Control tree size)
    • Dormant Pruning Invigorates
    • Summer Pruning Stunts
What if you don’t prune?

- Tree growth extends outward
- Shading of lower areas
- Small, poor colored fruit
Apple Thinning

• Improve size, color & finish
• Reduce biennial bearing
• Early is better – but more risky
• By hand
• With chemicals - by variety, with experience
  Carbaryl, Naphthaleneacetic Acid (NAA),
  Naphthaleneacetimide (NAD)
Full bloom to 55 days after full bloom
Thin by hand to 20 cm apart
Distribute evenly
Keep large fruit
Timing for chemical thinning = 10 - 15 mm
Apple Nutrition

- Leaf analysis
- Soil analysis
- Control weed competition
- Mature orchard:
  - 70-100 kg actual N per hectare per year
No Weeds Within 1 meter
Irrigate Frequently

Most roots are in the top meter.
No Water Stress - Ever

Do not place emitters on tree

Irrigate every 1-2 days in summer

Irrigate 2-4 times per month in the hot summer months with furrow irrigation
Pack & Store Apples Properly
Apple Pests

1. Codling moth
2. Aphids
3. Mites
4. Apple scab
5. Fire blight
Codling Moth

*Cydia pomonella*

- Can cause up to 100% damage
- Mating begins during or just after flowering (temp. dependent)
- 1 to 4 generations per season
- Overwinter on tree as larva
Pheromone traps
To monitor development and time sprays
Codling Moth Control methods

- Chemical
- Oil, virus, spinosad
- Pheromone confusion
Pheromone Confusion Dispensers

Mating Disruption

2+ Hectares

Males cannot locate females
Aphids curl leaves & stunt fruit
Woolly Apple Aphid
Mites

No water stress

Avoid dusty conditions

Spray if exceed threshold
Apple Scab  
Venturia inaequalis

- Needs free moisture to spread and infect
- Ascospores released during rain in spring
- Best temperature is 14-24°C (low as 2°C)
- 9-15 hours of wetness to infect
- Overwinters on fallen leaves
- Conidia = rapid spread spring & summer
Scab control

- **Plant Resistant variety**
- **Sanitation** – overwinters on leaves
- **Chemical control**
Fire Blight

*Erwinia amylovora*

- Bacteria – enters through flowers under warm, moist conditions
- Spreads inside shoot and kills rapidly
Fire Blight
Control Methods

• Cut shoot or branch 12 in. below infection zone
  – Sterilize shears between cuts
• Antibiotic or copper sprays during bloom
Powdery Mildew

Podosphaera leucotricha

Fungicides

Resistant Varieties
Viruses

- Mostly graft transmitted
- Use certified clean virus free materials

Flat limb

Mosaic
Other Disorders

Russetting
(chemicals, wetness)

Sun scald
(heat injury)
Bitter Pit

Calcium deficiency

- Ca to soil
- Ca foliar spray
- Do not over-fertilize (N)
- Postharvest Ca dip
**Burr Knot**
Root initials on exposed rootstock

**Woolly apple aphid**
on scion portion of tree
Acknowledgements

Paul Vossen, Connell, Farm Advisor, UC Cooperative Extension
University of California Integrated Pest Management Program