Back to Basics Horticultural Practices

M. Elena Garcia and the Apple Team

Fruit Trees

- Important factors for successful fruit production
  - Site selection
  - Proper planting
  - Adequate fertility
  - Variety and rootstock
  - Pruning and training

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Site Selection

- Survey
  - Soil conditions
  - Sun exposure
  - Available space
  - Frost pockets

Make a Map!!

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Site selection

- Soil conditions
  - Ideal soil for apples
    - slightly acidic
    - well drained
    - medium loam

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Site selection

- Soil Conditions
  - pH
    - Range 6.0-6.5
      - Availability of elements
  - Test your soil pH before planting
    - Follow up recommendations for soil amendments

Element availability according to pH
Soil Conditions

- Problems:
  - < 5.3
    - Bark measles due to excess Mn
    - Ca and Mg deficiencies become more acute
    - N and K become less available
    - Al can build up to become toxic

Soil Conditions

- Problems:
  - > 6.5
    - B, Cu, Mn, Zn, and Fe uptake seriously reduced
Site selection

- Soil fertility
  - Soil amendments
    - peat moss
    - lime
    - organic matter
    - mineral elements

- Soil conditions
  - Drainage
  - Soil type
    - clay
    - sandy
    - hardpan
  - Best soil: Sandy loam
Planting Site

- Sun exposure
- Row orientation
- North-south best

Light Penetration

Light penetration for four sides of a mature apple canopy (spur type ‘Delicious’/MM.111)

- East
- South
- West
- North

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Light Penetration

% of full radiation needed for various quality factors in apples

<table>
<thead>
<tr>
<th>Character</th>
<th>Satisfactory development</th>
<th>Unsatisfactory development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit size</td>
<td>&gt;50%</td>
<td>&lt;50%</td>
</tr>
<tr>
<td>Red color</td>
<td>&gt;70%</td>
<td>&lt;40%</td>
</tr>
<tr>
<td>Spur development</td>
<td>&gt;30%</td>
<td>&lt;25%</td>
</tr>
</tbody>
</table>

Planting Site

- Slope
  - A 4 to 8% slope is ideal.
  - A steeper than 10% slope may make it difficult to operate machinery.
  - Avoid areas at the bottom of the hill where cold air settles and frost pockets form.
Weed Management

Weed:
- Non-harvested plant that significantly reduces crop yield and or quality by competing for essential resources such as nutrients, water, or sunlight without providing for compensatory benefits.
Weed Management

- Integrated weed management
  1. Preventing resistance
     - Repeated use of same herbicide
     - Repeated mechanical weed control
Weed Management

- IPM
- Pre-plant eradication and exclusion
  - Herbicides
  - Pre-plant cover crops
  - Selection of rootstocks

Ground covers
- Care in choosing
  - Beneficial: Sudan grass and marigold may control some parasitic nematodes
  - Problems: Some ground covers may aggravate pests problem
    - Legumes may increase tarnish plant bug damage
Weed Management

 › Weed control area

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Weed Management

Total shoot growth of apple trees during first year in the orchard in relation to % of weed control within a 6 foot wide row strip (Merwin and Stiles, Ext. Bull 242)

<table>
<thead>
<tr>
<th>Weed-free area (%)</th>
<th>Shoot growth per tree (ft)</th>
<th>Growth reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>9.28</td>
<td>0</td>
</tr>
<tr>
<td>75</td>
<td>8.40</td>
<td>10</td>
</tr>
<tr>
<td>50</td>
<td>7.40</td>
<td>20</td>
</tr>
<tr>
<td>25</td>
<td>6.63</td>
<td>29</td>
</tr>
<tr>
<td>0</td>
<td>5.77</td>
<td>38</td>
</tr>
</tbody>
</table>
Weed Management

Effect of different timing and duration of weed control

![Bar chart showing increase in TCSA in 1991 for different weed control strategies.]

Weed-free time and duration (Merwin and Stiles, Ext. Bull 242)

Weed Management

Ratio of harvested crop value to yearly weed control cost

![Bar chart showing the ratio of harvested crop value to yearly weed control cost for different years.]

Ratio of crop value to weed control

Ratio of harvested crop value to yearly weed control cost

[Graph showing the ratio of crop value to weed control for different years (1993, 1994, 1995).]

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Weed Management

- Ground cover management systems
- Weed control strips with ground covers between rows
- Permanent ground covers
- Pre-plant cover crops
- Natural ground covers

Weed Management Practices

<table>
<thead>
<tr>
<th>TOOL</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivation</td>
<td>Effective</td>
<td>May damage soil structure</td>
</tr>
<tr>
<td></td>
<td>Non-selective</td>
<td>Spreads perennial weeds</td>
</tr>
<tr>
<td></td>
<td>Equipment readily available</td>
<td>May damage tree /roots</td>
</tr>
<tr>
<td></td>
<td>Considered “Green”</td>
<td>Long term control</td>
</tr>
<tr>
<td>Mulching</td>
<td>Effective</td>
<td>Availability of mulch</td>
</tr>
<tr>
<td></td>
<td>Non-selective</td>
<td>Cost of mulch/application</td>
</tr>
<tr>
<td></td>
<td>Holds moisture</td>
<td>Attractive to rodents</td>
</tr>
<tr>
<td></td>
<td>Considered “Green”</td>
<td>Must be free of seeds</td>
</tr>
<tr>
<td></td>
<td>Long-term control</td>
<td></td>
</tr>
<tr>
<td>Mowing</td>
<td>Rescue treatment</td>
<td>Weeds may still compete</td>
</tr>
<tr>
<td></td>
<td>Quick suppression</td>
<td>Quick regrowth</td>
</tr>
<tr>
<td></td>
<td>Equipment available</td>
<td>Several mowing required</td>
</tr>
<tr>
<td></td>
<td>Reduce seed spread</td>
<td>May damage young trees</td>
</tr>
<tr>
<td>Herbicides</td>
<td>Effective</td>
<td>Requires at least 2% OM</td>
</tr>
<tr>
<td></td>
<td>Easy to apply</td>
<td>Directed spray equipment</td>
</tr>
<tr>
<td></td>
<td>Can be selective</td>
<td>Effects on pest complex</td>
</tr>
<tr>
<td></td>
<td>Timely</td>
<td>Cost varies</td>
</tr>
</tbody>
</table>

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Table 2. Estimated cost per acre of orchard to establish and maintain natural and synthetic mulches, herbicides, grasses or cultivation in a 6-foot wide strip in a NY orchard Integrated weed and soil management in fruit plantings CCE-242

<table>
<thead>
<tr>
<th>System</th>
<th>Material ($/acre)</th>
<th>Labor ($/acre)</th>
<th>Total ($/acre/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay-straw</td>
<td>150-400</td>
<td>145</td>
<td>300-550</td>
</tr>
<tr>
<td>Woodchip</td>
<td>70</td>
<td>295</td>
<td>130-315(1-3yr)</td>
</tr>
<tr>
<td>1.2 mil poly</td>
<td>150</td>
<td>35</td>
<td>185</td>
</tr>
<tr>
<td>Herbicide</td>
<td>10-50</td>
<td>5</td>
<td>15-55</td>
</tr>
<tr>
<td>Mowed sodgrass</td>
<td>30</td>
<td>40</td>
<td>70-100</td>
</tr>
<tr>
<td>Clean cultivation</td>
<td>15</td>
<td>35</td>
<td>59</td>
</tr>
</tbody>
</table>

Weed Management

- Herbicides
- Types
  - Herbicides labeled for orchards
  - Herbicide efficacy on various annual weed species
# Orchard Nutrition

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## Generic Fertilizer Schedule for Apple Tree

*For general purposes only. To be used only when no test and soil analysis are available.*

<table>
<thead>
<tr>
<th>Element</th>
<th>Form</th>
<th>Time of Application</th>
<th>Ground</th>
<th>Foliar</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Urea</td>
<td>Pink and first cover</td>
<td>9#/ Ac (1X-3X)</td>
<td>2-4#/tree + 6 weeks 1-2#/tree + 6 weeks</td>
</tr>
<tr>
<td></td>
<td>Calcium nitrate</td>
<td>Before bloom</td>
<td>2-4#/tree</td>
<td>1-2# /tree</td>
</tr>
<tr>
<td>P</td>
<td>Ammonium nitrate</td>
<td>Before bloom</td>
<td>1-2# /tree</td>
<td>1-2# /tree</td>
</tr>
<tr>
<td>Ca</td>
<td>Calcium chloride</td>
<td>7 to 10 days APF</td>
<td>4-14# actual Ca /season 4-6 sprays 14 days apart</td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td>Dolomitic limestone</td>
<td>In the fall or Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulf-Po-Mag</td>
<td>Before bloom</td>
<td>2# /tree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Solubor</td>
<td>Prebloom, PF, 1st, or 3rd cover</td>
<td>4-8#/ Ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Granular</td>
<td>Before bloom</td>
<td>5-11#/ Ac</td>
<td></td>
</tr>
<tr>
<td>Mn</td>
<td>Manganese sulfate</td>
<td>Before bloom</td>
<td>5# /Ac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 sprays of Mn containing fungicide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td>Bordeaux</td>
<td>Dormant or post-harvest</td>
<td>4-6#/ Ac</td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>Zinc sulfate</td>
<td>Dormant or post-harvest</td>
<td>5-11#/ Ac</td>
<td></td>
</tr>
</tbody>
</table>
Mineral nutrition

- Nitrogen
- Potassium
- Calcium
- Magnesium
- Boron
- Phosphorous
- Manganese
- Copper
- Iron
- Zinc

Cultivars

- http://orchard.uvm.edu/uvmapple/hort/cultivars/index.htm
Variety and Rootstock

- Large selection
  - Apples ~10,000 cultivars
- Questions to consider
  - Uses
  - Maturity
  - Storage

Cultivar and Rootstock

- What to look for in a cultivar
  - Type and use for fruit
  - Disease resistance
  - Type of tree
  - Climate adaptability
  - Market demand
  - Time of harvest
  - Pollination
Cultivars and rootstocks

What to look for in a rootstock

- Hardiness
- Soil type adaptability
- Pest resistance
- Overall tree size
  - standard
  - semidwarf
  - dwarf

Rootstocks

Mark
M. 9
M. 7
M. 26
MM. 106
M. 111
Seedling

8-9 ft
>15 ft

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Rootstocks

- http://orchard.uvm.edu/uvmaple/hort/rootstocks/index1.htm

Proper planting

- When to plant?
  - Spring
    - If trees are bare-root
    - Late April or May
  - Fall
    - If trees are in containers
Proper planting

- Never let the roots dry out
  - Soak roots of bare-root trees 1-3 hrs before planting
- Hole should twice as large as the root system
- If putting any soil amendment, mix with soil that will be used to refill the hole

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Proper planting

- Prune roots
- Graft union should be 2”-3” above the soil line
- Pack the soil gently, but firmly
- Stake dwarf trees
- Place mouse guard at base of tree
- “Head back” to about 36” tall

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Adequate Fertility

- Major nutrients for growth are nitrogen, phosphorus, and potassium (N-P-K)
- As a rule, no fertilizer at planting time
- Soil preparation should be done in Fall before planting

Adequate Fertility

- After growth begins
  - 1/2lb of a 16% or 20% nitrate fertilizer
  - 8-10 inches from tree trunk
- AVOID OVER FERTLIZATION!!
**Adequate Fertility**

- For one year old and older trees
- When growth begins, 1/2 lb of 10-10-10/ age of tree
- In a band or a circle at least 18 inches from the trunk
- No fertilizers after June

---

**Fertility**

- Nutrient disorders
Fertility

- Calcium deficiency

- Mg deficiencies
Fertility

- Boron deficiency
- Boron toxicity

Fertility

- Zn deficiency

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Fruiting Trees

- Pollination
- Most fruit trees are not self-fertile
  - cross-pollination
- Cultivars' bloom period should coincide
- Tetraploid apple cultivars such as Mutsu produce sterile pollen
- Honey bees are the primary pollinators

Fruit Thinning

- Removing some of the developing fruit
  - To provide top quality, full-sized fruit
  - To ensure good return bloom the following year
- Time of thinning depends on the time of flower initiation according to the species
### Time of flower initiation of apples

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Initiation</th>
<th>Flowers borne on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Mid-June-mid-July</td>
<td>Terminal buds. 2yr.spurs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FRUIT</th>
<th>TYPE OF BUDS</th>
<th>FLOWER BUD LOC. AND TYPE</th>
<th>INFLORESCENCE</th>
<th>FLOWER NUMBER</th>
<th>TIME OF FLOWER INITIATION</th>
<th>CHARC. 1ST YEAR WOOD</th>
<th>CHARC. 2ND YEAR WOOD</th>
<th>CHARC. 3RD YEAR WOOD</th>
<th>WOOD PRODUCTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Vegetative and mixed</td>
<td>Terminal epigynous</td>
<td>Determinate</td>
<td>5</td>
<td>Early summer</td>
<td>Where buds are attached</td>
<td>Will initiate flower buds for next season</td>
<td>Where fruit is found</td>
<td>Youngest wood most productive</td>
</tr>
<tr>
<td>Pear</td>
<td>Vegetative and mixed</td>
<td>Terminal epigynous</td>
<td>Indeterminate</td>
<td>7-8</td>
<td>60 days past full bloom</td>
<td>Similar to apple</td>
<td>Similar to apple</td>
<td>Similar to apple</td>
<td>Similar to apple</td>
</tr>
<tr>
<td>Peach</td>
<td>Unmixed</td>
<td>Lateral perigynous</td>
<td>Solitary</td>
<td>1</td>
<td>Midsummer</td>
<td>Where fruit is located</td>
<td>Interior flower buds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cherry</td>
<td>Unmixed clusters</td>
<td>Lateral perigynous</td>
<td>Cluster</td>
<td>2-4</td>
<td>July, after crop is harvested</td>
<td>Sweet Cherry-sours</td>
<td>Sweet Cherry-best sours</td>
<td>Long productivity 10-15 years in sweet cherry</td>
<td></td>
</tr>
<tr>
<td>Plum</td>
<td>Unmixed</td>
<td>Lateral perigynous</td>
<td>1-3 flowers/bud</td>
<td>1-3</td>
<td>Mid to late summer</td>
<td>Most vigorous sours</td>
<td>Fruit production</td>
<td>Similar to apple, spurs older than 4 years may die</td>
<td></td>
</tr>
</tbody>
</table>

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Fruit Thinning

- How to thin apples by hand
- As early as possible after bloom
- Use small hand pruners
- Cut off the young fruit by their stems
- Leave the largest fruit
- Fruit should be 4-6 inches apart
- Goal: Keep the “king” fruit
- June drop

Fruit thinning

- Fruit thinners
## Thinning

**Table 9. Thinning Windows (Apple Thinning Guide)**

<table>
<thead>
<tr>
<th>Thinning Window</th>
<th>Bloom</th>
<th>Petal Fall</th>
<th>Early Fruit Set</th>
<th>Late Fruit Set</th>
<th>Closing</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAFB</td>
<td>5 to 10</td>
<td>11 to 15</td>
<td>16 to 20</td>
<td>20+</td>
<td></td>
</tr>
<tr>
<td>Fruit Size (mm)</td>
<td>FF to 8</td>
<td>8 to 12</td>
<td>16 to 20</td>
<td>20+</td>
<td></td>
</tr>
<tr>
<td>Stage (mm)</td>
<td>Full Petal Bloom</td>
<td>6</td>
<td>10</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>General Thinning Success</td>
<td>Fair</td>
<td>Best</td>
<td>Good</td>
<td>Good</td>
<td>OK</td>
</tr>
<tr>
<td>Past Thinning</td>
<td>Traditional Window</td>
<td>Rescue thinning</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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## Thinning recommendations

**Table 10. Specific thinning recommendations**

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Stage of fruit development</th>
<th>Petal fall to 3 mm</th>
<th>7 to 12 mm</th>
<th>15+ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>McIntosh</td>
<td>Sevin</td>
<td>Sevin +2.5-7.5 NAA or Sevin +50-75 Accel</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Cortland</td>
<td>Sevin</td>
<td>Sevin +75-100 Accel</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Delicious (Primal at bloom)</td>
<td>Sevin</td>
<td>Sevin (+75 Accel if needed)</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Empire</td>
<td>Sevin</td>
<td>Sevin +7.5-10 NAA or Sevin +50-75 Accel</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Macoun*</td>
<td>Sevin +5-7.5 NAA</td>
<td>Sevin +5-7.5 NAA</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Macoun (alternative)</td>
<td>Sevin</td>
<td>Sevin +75-100 Accel</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Golden Delicious</td>
<td>Sevin</td>
<td>Sevin +10-15 NAA or Sevin +75-100 Accel</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Mutsu</td>
<td>Sevin</td>
<td>Sevin +5-7.5 NAA</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Fuji</td>
<td>Sevin</td>
<td>Sevin +75-100 Accel</td>
<td>Sevin</td>
<td></td>
</tr>
<tr>
<td>Gala</td>
<td>Sevin</td>
<td>Sevin +5-7.5 NAA</td>
<td>Sevin</td>
<td></td>
</tr>
</tbody>
</table>

In all cases, Sevin is recommended to be applied at 1 qt Sevin XLR per acre, and NAA and Accel recommendations are in ppm.

* According to Jim Schupp (U. Maine), NAA at 10–15 PPM as close to petal fall as possible + Sevin followed by a second application of NAA without Sevin is very effective.
Fruit Thinning

As a general rule for apples, 18 leaves are necessary for one apple to develop satisfactorily

Harvesting

- Apples are matured
- Stems separate easily from spur
- Seeds are brown
- One of the best tests is the starch index
Apple bud stages

DORMANT (D)
SILVER TIP (TP)
GREEN TIP (GT)
Apple bud Stages (Cont.)

Half inch Green (HIG)

Tight Cluster (TC)

Pink (P)

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Apple bud stages

Full Bloom (FB)

Petal Fall (PF)

Fruit Set (FS)

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Pruning and Training

See Presentation on Pruning and Training

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Thank You

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