Plan BEFORE Planting

• The fate of the planting is determined before the crop is set out

What To Grow?

• What is not being grown in your area?
  – Is this an opportunity?
    • No competition
    • High returns
  – Or a Red Flag?
    • No market demand
    • Serious production limitations
    • Limited availability of equipment & supplies

What to Grow?

• Market demand
• Site limitations
  – Winter damage
  – Spring frosts
  – Pest pressures
• Species
  – Cold hardiness
  – Chilling requirement
• Varieties
  – Bloom time
  – Pest resistance
• Rootstocks
  – Pest resistance
  – Size control
  – Precocity

Variety Selection

• Pest resistance
  – Does NOT mean immunity
  • 2005 – bacterial spot was a problem on “resistant” varieties of peach
  – May not possess resistance to multiple pests
    • Prima apple is highly resistant to scab, but highly susceptible to cedar apple rust
• Market demand
  – Prima apple is harvested at the same time as Gala, which is in much higher demand
### Disease Resistant Apple Varieties*

*1 = susceptible, 9 = immune, U = unknown

<table>
<thead>
<tr>
<th>Variety</th>
<th>Apple Scab</th>
<th>Cedar Apple Rust</th>
<th>Fireblight</th>
<th>Powdery Mildew</th>
</tr>
</thead>
<tbody>
<tr>
<td>CrimsonCrisp</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Enterprise</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Goldrush</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>CrimsonTopaz</td>
<td>9</td>
<td>U</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>CrimsonGold</td>
<td>9</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
</tbody>
</table>

### Dwarf Apple Rootstock Pest Resistance

- M9 337 – fireblight susceptible
- M9 Nic 29 – fireblight susceptible
- Bud 9 – very winter hardy, resistant to collar rot, less fireblight susceptible than M9
- G 16 – resistant to collar rot, strong resistance to fireblight
- EMLA 26 – does not tolerate wet feet, highly susceptible to fireblight & wooly apple aphids
- G 11 – fireblight resistant

### Blackberry Disease Susceptibility

<table>
<thead>
<tr>
<th>Variety</th>
<th>Rosette</th>
<th>Orange Rust</th>
<th>Anthracnose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickasaw</td>
<td>S</td>
<td>?</td>
<td>S</td>
</tr>
<tr>
<td>Choctaw</td>
<td>S</td>
<td>R</td>
<td>R(?)</td>
</tr>
<tr>
<td>Kiowa</td>
<td>S</td>
<td>R(?)</td>
<td>S</td>
</tr>
<tr>
<td>Shawnee</td>
<td>VS</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>Arapaho</td>
<td>R</td>
<td>?</td>
<td>R(?)</td>
</tr>
<tr>
<td>Apache</td>
<td>R(?)</td>
<td>R(?)</td>
<td>R(?)</td>
</tr>
<tr>
<td>Navaho</td>
<td>R</td>
<td>VS</td>
<td>R(?)</td>
</tr>
<tr>
<td>Ouachita</td>
<td>R</td>
<td>R(?)</td>
<td>S</td>
</tr>
<tr>
<td>Prime Jim</td>
<td>S*</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Prime Jan</td>
<td>S*</td>
<td>R</td>
<td>S</td>
</tr>
</tbody>
</table>

R = resistant  R(?) = none observed  S = susceptible  VS = very susceptible

* = Not an issue with primocane bearers grown for fall crop only

### Deal With a Reputable Nursery

- Purchase good quality trees
  - Plant costs are negligible when compared to total establishment costs
- Organic planting stock is required
- If not available, documentation of attempts to find it and lack of availability must be done

### Certified Organic Tree Fruit & Small Fruit Plants

- Trees of Antiquity (CA)
  - [http://www.treesofantiquity.com/](http://www.treesofantiquity.com/)
- Rolling River Nursery (CA)
  - [www.rollingrivernursery.com](http://www.rollingrivernursery.com)
- Hidden Springs Nursery (TN)
  - [www.hiddenspringsnursery.com](http://www.hiddenspringsnursery.com)
- Cottle Strawberry Nursery (NC)
  - [www.cottlefarms.com](http://www.cottlefarms.com)

### If Organic Planting Stock is Unavailable ---

- Document search for organic stock & its lack of commercial availability
- Most certifiers interpret the organic standards as requiring organic management of non-organic planting stock for at least 12 months before harvesting a crop that is to be sold as certified organic
“Live where you farm,” not “Farm where you live.”

Site Selection
• Soils – type, depth, drainage, fertility, pH
• Water – availability, quality
• Frost/freeze
• Previous cropping history
• Topography
• Wildlife

Elevation
For every 100' increase in elev., expect 5 to 10°F increase in temp. during a radiation frost event

North
Less potential for winter injury
Plants stay dormant later - less chance for frost

Intermediate
West between north & south
Morning sun reduces disease pressure

East
Increased potential for winter injury
Plants start growth earlier - increased potential for frost
Soils tend to be drier, warmer and thinner

South

Previous Cropping History
• Persistent herbicides
• Verticillium susceptible crops & weeds
  – tomato, pepper, potato, eggplant, strawberry, raspberry, nightshade, ground cherry, horseradish, lambsquarter, pigweed, cocklebur
• Cotton root rot
• Nematodes

Water Quality?
A critical year in fruit production is the one before planting – the success or failure of a fruit crop is often determined before the plants are set.

Site Preparation
- Soil testing
- Elimination of noxious weeds
- Facilitation of good air and water drainage
- Floor management
- Elimination of host plants in the vicinity of the planting

Depth of Sampling
- 8" to 16"
- 16"
- 8 to 2"

Blueberry Production Timeline
- Preplant Site Preparation
- Planting
- Defruit
- 1st crop – rabbiteye

Determining Nutritional Needs: Postplant
- Soil testing
- Tissue analysis
- Growth & fructing
- Past experience
Objectives of a Nutrient Management Program

- Healthy plants
- High yields
- Quality fruit
- Consistent production

Nitrogen Availability

- Manures and compost
  - 50% available during year of application
  - 90% available in application year with fresh poultry manure
  - Balance available during subsequent years (be sure to figure it in annual applications)

Manure as Fertilizer

- Fertilizer value usually highly variable
- Unbalanced in regards to N, P, K
- Specific application rates will be impossible to recommend
- Typical application rates:
  - Most manures – 1 to 4 tons/acre
  - Poultry manures – 1 to 2 tons/acre

Timing of Manure Applications

- 120 days pre-harvest in crops where fruit may be in contact with the soil or soil can be splashed onto the fruit from rainfall or irrigation
- 90 days preharvest where fruit is elevated or shielded from soil contact
- Properly composted manures can be applied at higher rates & at times closer to harvest

Organic Fruit Production – Pest Control

Why Control Wildlife in Fruit Crops?

- Economic losses
  - Fruit destroyed or consumed by wildlife
  - Increased disease & insect pressure with damaged fruit
  - Damage to plants and cropping system
    - Feeding on succulent shoots
    - Girdling or rubbing on plants
    - Puncturing plastic
- Food Safety
Wildlife Damage Prevention Categories

- Habitat modification
- Exclusion
  - Fencing
  - Netting
- Scare devices (visual & auditory)
- Repellents (taste & smell)
- Removal
  - trapping
  - shooting

Maintaining plants in good health is important in insect and disease management

Pest Management Strategies

- Cultural Controls
- Mechanical Controls
- Biological Controls
- Chemical Controls

Cultural Controls (New Plantings)

- Site Selection
- Crop Rotation
- Soil Preparation
- Cultivar Selection
- “Clean” Planting Stock
- Row Spacing & Plant Density

Cultural Controls (established plantings)

- Mulching (first year)
- Weed & Grass Control
- Pruning
- Fertilization
- Irrigation
- Sanitation
- Habitat Modifications

Mechanical Controls

- Keeping pests away from crops
  - Traps, row covers, netting
- Removing pests
  - Hand removal, vacuuming
- Removing diseased plants
- Cultivation & hand weeding
**Biological Controls**

- Mating disruption pheromones
- Microbial pesticides
  - (beneficial pathogens that kill pests)
- Natural enemies
  - Encourage predators

**Biological Control of Insects:**

- Can be enhanced by cover crops & habitat management
- Timed release of beneficial insects
  - Where a known pest appears predictably & can be controlled by specific biological agent
  - Predatory mites
  - Lady beetles
  - Green lacewings
  - Trichogramma wasps

**Chemical Control**

<table>
<thead>
<tr>
<th>Fungicides</th>
<th>Insecticides</th>
<th>Herbicides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur</td>
<td>Rotenone</td>
<td>Corn gluten meal (Preen)</td>
</tr>
<tr>
<td>Copper</td>
<td>Bacillus thuringensis</td>
<td>Vinegar</td>
</tr>
<tr>
<td>Serenade (Bacillus subtilis)</td>
<td>Azadirachtin</td>
<td>Lime/lemon juice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clove/cinnamon oil</td>
</tr>
</tbody>
</table>

**Disease Control**

- Know:
  - susceptibilities of species, varieties and/or rootstocks
  - the symptoms of the disease
  - when infection occurs
  - what weather conditions favor infection
  - control measures

**Apple Scab**

- Primary Infection
- Secondary Infection

**Mill's Chart for Apple Scab Infection**

<table>
<thead>
<tr>
<th>Ave. Temp. °F</th>
<th>Hours Required for Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Light</td>
</tr>
<tr>
<td>45</td>
<td>17</td>
</tr>
<tr>
<td>50</td>
<td>14</td>
</tr>
<tr>
<td>55</td>
<td>11</td>
</tr>
<tr>
<td>60</td>
<td>9.5</td>
</tr>
<tr>
<td>63 – 75</td>
<td>9</td>
</tr>
<tr>
<td>76</td>
<td>9.5</td>
</tr>
<tr>
<td>77</td>
<td>11</td>
</tr>
<tr>
<td>78</td>
<td>13</td>
</tr>
</tbody>
</table>
# of Wetting Hours Required for Black Rot Infection at Various Temperatures

<table>
<thead>
<tr>
<th>Ave. Temperature (°F)</th>
<th>Hours of Leaf Wetness</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>24</td>
</tr>
<tr>
<td>55</td>
<td>12</td>
</tr>
<tr>
<td>60</td>
<td>9</td>
</tr>
<tr>
<td>65</td>
<td>8</td>
</tr>
<tr>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>75</td>
<td>7</td>
</tr>
<tr>
<td>80</td>
<td>6</td>
</tr>
<tr>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>90</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: R. A. Spotts, Ohio State Univ.

Powdery Mildew

- Conditions favoring infection:
  - Rel. humidity > 60%
  - Temp. 50 - 77°F
  - 66 - 72°F optimum
- Critical growth period:
  - Tight cluster to pink through 1st or 2nd cover.
- Pressure greater following mild winter

Cultural & Mechanical Practices for Pest Control - Preplant

- Site selection:
  - Elevated, well-drained, full sun, consider previous cropping history
- Site preparation:
  - Adjust soil pH, P, K, Ca & Mg
  - Eliminate noxious weeds
  - Eliminate barriers to air drainage
  - Eliminate alternate hosts for pests
- Plant selection:
  - Select types of fruits & varieties suited to your area
  - Purchase plants form reputable nurseries, inspect plants upon receipt
  - Consider pest resistant varieties/rootstocks

Cultural Practices for Pest Control - Postplant

- Pruning to remove diseased & insect-infested wood, promote good sunlight, air & spray penetration throughout the canopy
- Conservative, timely nitrogen application
- Trickle irrigation instead of overhead
- Crop thinning
- Timely harvest
- Sanitation

Organic Fruit Production – Floor Management
Orchard Floor Management

Floor Management

- Permanent sod between rows
  - Serves as a deceleration & diffusion strip for runoff water
  - Support for equipment
- Mulching or shallow cultivation around trees or down tree row with high density plantings

Mulching

- Weed control
- Uniformity in:
  - Soil moisture
  - Soil Temperature
- Fertility
- Maintain or enhance soil organic matter levels

- Voles
  - Keep mulches 8 to 10 inches away from trunk
  - Use trunk guards on young trees
- Must re-apply organic mulches to maintain benefits

Irrigation – Overhead or Trickle

Why Prune?

- Promote growth in desired areas
- Stiffen limbs
- Remove dead, broken, diseased & insect infested limbs
- Remove unfruitful branches or canes
- Promote development of new shoots for future crops
- Adjust crop size, increase fruit size

Sunlight is the key to fruit production

- Reduces pest problems
- Increases fruit quality (color, soluble solids)
- Maintains fruitfulness of the interior portions of the plant
Organic Fruit Production – Cropping Systems

Cropping Systems - Strawberries

- Matted Row
- Annual Production
- Less disease pressure

Advantages of a Single-Cropping System:

- Cane thinning, detailed pruning & tying are eliminated
- Cold injury to buds is eliminated
- Winter damage from voles & rabbits is eliminated
- Spur blight, anthracnose, cane blight & several other diseases are reduced
- Sap beetle problems are reduced, many other insect problems are eliminated
- Application of fertilizers & pesticides is easier

Primocane Crop Only

- Allow Primocanes to grow, Maintain row width 12 – 18 in.
- Primocane Harvest
- Mow planting to ground in late winter

Alternate Year Cropping

Rotation -
- 1st year:
  - Crop ½ of the field, mow off canes in winter
- 2nd year
  - Crop the 2nd half of the field, grow primocanes on the 1st half
- Repeat sequence in following years

Alternate Year Cropping

- Increased primocane growth
- Heavier yields in floricane rows
- Easier management
- Reduced pruning costs
- Alternate row cropping increases air movement through planting
- Lessens pest carryover
Use of Protective Structures

- Season extension
- Increased yields
- Less disease pressure
- Physical exclusion of some insects & wildlife

Questions?

Dave Lockwood
dlockwood@utk.edu
(865) 974-7208
Fruit Notes
www.utextension.utk.edu/publications/