History and Origin

History and Origin Presentation

Temperate zone, deciduous trees
Origin in areas with cold winters
Mechanisms for winter dormancy and spring budbreak and flowering
Generally adapted for animal dispersal
   Colorful fruit
   Often seeds are poisonous

Family: Rosaceae

Subfamily: Pomoideae

Subfamily: Prunoideae

Subfamily: Pomoideae: Pome fruits
   Malus (apple)
   Pyrus (pear)
   Cydonia (quince)

Subfamily: Prunoideae: Drupes or stone fruits
   Prunus (peach, nectarine, cherry, apricot, almond)

Malus (apple)
Native to the Caucasian Mountains, Russia
~ 28 species, mostly European, some American species
Obligate cross-pollination
Malus x domestica - domestic apple
   Cultivated by primitive man
   Evidence of domestication by 10th century BC
   In 9th BC, in The Odyssey, Homer wrote about apple trees
   Cultivars and Rootstocks
      All commercially sold apple trees consist of two parts: Scion and stock
Propagation
   Greece ~ 300 BC
   Romans refined the practice
   Extremely important
      Heterozygous
Difficult to root
Cultivars and varieties
3rd century BC : 7 varieties
1st century AD : 36 varieties
Today : >10,000 varieties
Pearmain: Oldest European named cultivar still in existence
Roxbury Russet: First American named apple

Vermont Apple Industry
Colonial - prior to 1800
Seedlings or ‘natural varieties’
Cider-apple time - 1800-1875
  in 1810 :125 distillers/12300 gal brandy
Farm orchards - 1875-1890
Commercial - 1910-1940
Specialized commercial - 1940-date
McIntosh
  Ontario farm (1811)
  Brought to Newport VT in 1868

Pyrus (pear)
Native to most of Europe, the Near East, and temperate Asia
One ornamental evergreen in Japan
~ 20 species
Obligate cross-pollination
Pyrus communis - common or European pear
Pyrus pyrifolia - Chinese or sand pear

History and Origin
Pyrus communis- Common or European pear
Domestication 2500 years ago during
~ 300 BC Theophrastus recorded 3 cultivars
~ 50 BC, Romans knew 40 cultivars
By 1600, in Europe, 1600 cultivars
Most older cultivars were firm, crisp types
Today’s cultivars are soft buttery
Introduced to North America in the 17th century
Not many new cultivars have been developed

Prunus
~ 150 species
Subgenus Amygdalus
Prunus persica - peach, nectarine
Prunus amygdalus - Almond
Peach - Mountains of western China and Tibet
  Mostly self-fertile
Almond - Mediterranean basin and Southwestern Asia
  Mostly self sterile
Peaches
Archeological remains ~ 4000 BC
Object of reverence in Chinese culture
Introduced to Europe at the beginning of the Christian era
Very adaptable to climatic conditions

Almond
Neolithic and Bronze age
Remains of plantings 3000 BC
Not adapted for bird dispersal
Recessive gene for not producing cyanide

Subgenus Prunophora
Prunus domestica - European plum
Center of origin : Europe
Domestication in Rome and Greece
Hexaploid (2N= 48)
cross between a 2n=16 and 4n=32
Very few new cultivars
Prunes
Prunus americana - North American plum
Prunus salicina - Japanese plum

Prunus armeniaca - apricot
Native to China and Siberia

Subgenus Cerasus
Prunus avium - sweet cherry
Prunus cerasus - sour cherry
Native to southeast Europe and western Asia
Will cross to form hybrids (Duke)
Some sweet cherry cultivars are self-sterile

Fruit Production Statistics
Fruit Production Statistics Presentation

Botany of Fruit Trees

Rosaceae
Mostly in Eurasia and North America
Temperate zones
Adaptation mechanisms
Trees and shrubs
Mostly deciduous

Most commercial cultivars consist of
Stock (root)  
Scion (shoots, top part)  

Advantages of grafting  
Selecting the cultivar  
Climate adaptability  
Market demands  
Insect and disease resistance  
Selecting a rootstock  
Size  
Precocity (juvenility)  
Climate adaptability  
Site adaptability  

Apple  
\( X = 17 \)  
Somatic number : 34, 51, 65, 85  
Inflorescence : 5-6 flowers  
cyme -a central flower opens first and later flowers are borne on branches below it.(determinate, king blossom)  
Petals in 5  
Stamens : 15- 30  
Ovary: epigynous (inferior)  
Fruit : nonovarian calyx and receptacle  

Pear  
\( X = 17 \)  
Somatic number : 34, 51, 65  
Inflorescence: umbel-like raceme (indeterminate)  
Petals in 5  
Stamens : 20- 30  
Ovary: epigynous (inferior)  
Fruit : nonovarian calyx and receptacle  

Peach  
\( X = 8 \)  
Somatic number : 16  
Inflorescence : solitary  
Petals in 5'  
Stamens : numerous  
Ovary: perigynous  
Fruit : ovary wall
Vegetative and Reproductive Growth
FRUIT BUD, FLOWER, AND WOOD CHARACTERISTICS

Apple
As a general principle, all buds of the apple tree are attached to 1 year old wood
Flower buds usually occupy a terminal position
Highest quality flowers on 1-25 cm long shoots
Flowering shoots may extend from 0.1 cm to 1 m
Number and quality of flowers decrease in the shorter and longer limits
Length of shoot is typical of the variety

1 year old wood
Best for fruiting when growth is 1 cm-25 cm
Very strong growing long shoots produce fruitful spurs the following year

2 year old wood
Most valuable to the apple tree
Buds originating from this wood are prone to flowering and less biennial bearing

3 year old wood
It bears fruit for the first time

4 year old wood and older
Branched fruiting spur complex
Due to lack of nutrients and light, and injury due to pests, this wood is becoming unproductive

Peach
Flowers develop in the lateral leaf axils
Vigorous shoots needed to set fruit abundantly
Long, 1 year old shoots contribute the most to fruiting
Coordination of root and shoot growth

**Stock and scion growth relationship**

**Source – Sink interaction**

Leaves and other green tissues are the original sources of assimilates. Most assimilates are exported (translocated) to sinks for growth, maintenance, and storage. During vegetative growth, roots, stems, and young leaves are competitive sinks. Sink demands change during the life cycle of the plant. Leaves become autotrophic when 1/3 to 1/2 of their final area is developed. After flowering, the reproductive sink becomes very strong, and limits the assimilate partitioned to vegetative sink.

Fruits are very strong sinks. The presence of fruit effectively limits the growth of the tree in apples. 200 cm² of leaf area is needed to grow a 100g apple. An additional 75 cm² are needed for each increment of 25g.

<table>
<thead>
<tr>
<th>FRUIT</th>
<th>TYPE OF BUDS</th>
<th>FLOWER BUDS</th>
<th>INFLORESCENCE</th>
<th>FLOWE R NUMBER</th>
<th>TIME OF FLOWER INITIATION</th>
<th>CHARC. 1ST YEAR WOOD</th>
<th>CHARC. 2SN 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>Terminally epygenous</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>Terminally epygenous</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 hypogenous</td>
<td>Solitary</td>
<td>1</td>
<td>Mid-summer</td>
<td>Where fruit is located</td>
<td>Inferior flower buds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cherry</td>
<td>Unmixed clusters</td>
<td>Lateral hypogenous</td>
<td>Cluster</td>
<td>2-4</td>
<td>July, after crop is harvested</td>
<td>Sweet Cherry-spurs Sour cherry-long shoots</td>
<td>Sweet Cherry-best spurs Sour cherry-</td>
<td>Long productivity 10 -15 years in sweet cherry</td>
<td></td>
</tr>
<tr>
<td>Plum</td>
<td>Unmixed</td>
<td>Lateral hypogenous</td>
<td>1-3 flowers/ bud</td>
<td>1-3</td>
<td>Mid to late summer</td>
<td>Most vigorous spurs Fruit production</td>
<td></td>
<td>Similar to apple, spurs older than 4 years may die</td>
<td></td>
</tr>
</tbody>
</table>
Roots
Regulate the growth and performance of fruit trees
Interact with the soil
1. Water uptake
2. Assimilation of nutrients
3. Storage organs for carbohydrates
4. Genetic control over the aerial portion
5. Size
6. Date of bloom
7. Amount of bloom
8. Precocity
9. Time of harvest
10. Winter hardiness

Resistance
1. Vertebrates
2. Diseases
3. Insects

Structure for support

Anchorage

Root growth
**Root distribution**
Distribution varies according to
* the soil profile
* Oxygen concentration and moisture
Majority of roots in the top 25-50 cm

**Water uptake**
Water use is directly related to tree productivity even under conditions when the trees are not visibly stressed
Dry weight increases in apples and peaches is proportional to the transpiration
General order for water requirements:
   Quince>pear>plum>peach>apple>cherry>sour cherry>apricot

Apoplastic
Symplastic
   Osmosis
The water status of a plant is measured by its water potential
- Osmotic potential arising from the dissolved solutes in the water
- Turgor potential arising from balance between internal and external pressures
- Matric potential arising from the capillary forces at the water-air interface
- Gravitational potential

Drought tolerant rootstocks usually have wide spreading roots which tend to grow downward
Drought prone rootstocks are relatively confined and have many feeder roots. They are very efficient at extracting water from their confined area

**Nutrient Uptake**
Passive
Active

**Growth patterns**
Root growth
See figures 1 and 2 in Chapter 5 Coordination of root and shoot growth in your textbook, *Tree Fruit Physiology*
In fruit trees, most absorption of water and minerals occur in the root hairs and root tips.
The maximum growth rate for apples and cherries is \(~1\) cm/day

Growth is faster at night in apple roots

Young roots in apple are initially white, with short root hairs, after 1-4 weeks, the root begins to turn brown

Apple roots
  Extension
  Lateral

2 periods

Early spring
Late summer

Shoot growth

Begins at bud break till mid-summer
Extension may stop, but shoot, branch and trunk diameter continue to increase
Spur growth
  Usually 2 to 6 weeks after bud break
Spur leaves
First to emerge, but only maintained for 60 to 90 days
Flower bud formation
  Initiation early to midsummer
Relative rootstock sizes
COMPARISON OF APPLE ROOTSTOCK SIZES

COMPARISON OF CHERRY ROOTSTOCK SIZES