Tropical Fruits
Minor Species of the Americas

Immense diversity
Potential for economic development

A Few Species Dominate the Market

89% of the market
- Citrus
- Bananas and plantains
- Mangos
- Pineapple

5% of the market
- Papayas
- Avocados
- Dates

Other 6% of the Market
Regionally Important

- Americas (1,000)
  - Cherimoya
  - Sugar apple
  - Soursop
  - Guava
  - Sapodilla
  - Sapote
  - Passion fruit

- Africa (1,200)
  - Tamarind

- Asia (800)
  - Breadfruit
  - Jackfruit
  - Mangosteen
  - Rambutan
  - Durian
  - Snake fruit

Minor Fruits from Central and South America

Annonaceae
Myrtaceae
Passifloraceae
Sapotaceae

Minor Fruits from Central and South America

- Annonaceae
  - Annona cherimola - Cherimoya
  - Annona muricata - Soursop
  - Annona squamosa - Sugar Apple

- Myrtaceae
  - Psidium guajava - Guava

- Passifloraceae
  - Passiflora edulis - Passion fruit

- Sapotaceae
  - Manilkara zapota - Sapodilla
  - Pouteria sapota - Sapote

Annonaceae
“The masterpiece of nature”
Mark Twain
Family Annonaceae

- Over 120 genera and 2,000 species
  - Most important genera Annona species
  - Temperate species - Asimina triloba
    - Paw paw, poor man’s banana
    - Understorey tree
    - Eastern North America

Origin of Annonaceae

- A. muricata
  - Soursop
  - Antilles and northern South America
- A. cherimola
  - Cherimoya
  - Andes in Ecuador and Peru

Adaptation of Annona species

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Altitude (m)</th>
<th>Best growth (°C)</th>
<th>Best fruiting (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cherimola</td>
<td>Cherimoya</td>
<td>700-2400</td>
<td>7-18C min</td>
<td>8-12C min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15-28 max</td>
<td>18-22C max</td>
</tr>
<tr>
<td>muricata</td>
<td>Soursop Guanábana</td>
<td>0-1000</td>
<td>Most tropical</td>
<td>Fruit set</td>
</tr>
<tr>
<td>squamosa</td>
<td>Sugar apple Sweetsop</td>
<td>0-1000</td>
<td>15-25 min</td>
<td>17-21C min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25-32 max</td>
<td>25-30C max</td>
</tr>
</tbody>
</table>

Annona species

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>Tree size</th>
<th>Fruit size</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>cherimola</td>
<td>Cherimoya</td>
<td>5-9 m</td>
<td>Medium</td>
<td>Subtropical Citrus climate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-30 ft</td>
<td></td>
<td>Light frosts OK</td>
</tr>
<tr>
<td>muricata</td>
<td>Soursop Guanábana</td>
<td>7.5-9 m</td>
<td>Large</td>
<td>Tropical</td>
</tr>
<tr>
<td>squamosa</td>
<td>Sugar apple Sweetsop</td>
<td>3-6 m</td>
<td>Small to medium</td>
<td>Hot, dry tropical climates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10-20 ft</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Flower Structure

- Three exterior petals
- Multiple stamens and pistils

Flower to Fruit - Sugar apple

- Alexander, Schekifeld and Frodsham, 1987. Some tree fruits for tropical Australia. CSIRO.
**Aggregate Fruit**

*One flower - multiple pistils*


**Cherimoya**

*A. cherimola*

- **Fruit** - Aggregate
- **Medium**
  - Normally 150-500 g
  - Up to 2.7 kg
  - 4-8" x 1-4"
- **Shape**
  - Conical to heart shaped
  - Smooth to covered with rounded protuberances

- **Skin**
  - Thin to thick
- **Flesh**
  - Snow white
  - Highly aromatic
  - Many seed

**Soursop**

*Guanábanana* 

*A. muricata*

- **Fruit** - Aggregate
- **Large**
  - 1 to 6.8 kg
  - 4-12" x 1-6"
- **Shape**
  - Ovoid
  - Heart shaped
  - Oblong conical
- **Skin**
  - Bitter
- **Flesh**
  - White, cottony
  - Highly aromatic
  - Brown seed

**Sugar Apple**

*A. squamosa*

- **Fruit** - Aggregate
- **Small to medium**
  - < 0.5 kg
  - 2.3 - 4" long
- **Shape**
  - Nearly round, Ovoid or conical
  - Knobby segments
- **Skin**
  - Thick
- **Flesh**
  - Creamy white
  - Highly aromatic
  - Many seed
  - Carpel adhere loosely

**Atemoya**

*A. cherimola x A. squamosa*

- **Fruit** - Aggregate
  - Intermediate between cherimoya and sugar apple
- **Growth requirements**
  - Intermediate between cherimoya and sugar apple

**Propagation - Annona spp**

- **Seed - Traditional**
  - Stores dry for 2-4 years
  - Gives variable fruit size and quality
- **Grafted onto seedlings**
  - Uniform fruit quality
  - Earlier fruiting
  - 1-2 years earlier
- **Rootstock Used**
  - Cherimoya
  - *A. cherimola or reticulata*
  - Soursop
  - *A. muricata or reticulata*
  - **NOT** squamosa or cherimola
  - Sugar Apple
  - *A. reticulata or squamosa*
**Production -**

**Precocity**
- Cherimoya: Bears in 3-5 years, Maximum yields in 10th year
- Soursop: Bears in 3-4 years
- Sugar apple

**Yields**
- Cherimoya: 25-80 fruit per tree
- Soursop: Shy bearer
  - 12-24 fruits/tree
  - 5-16 mt/ha
- Sugar apple: 50-100 fruits/tree

**Pollination**
- Hand pollination increases yields
- Beetles are pollinators

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**Soil - Annona species**

**Cherimoya**
- Best
  - Medium soil
  - Medium fertility

**Soursop**
- Best
  - Deep, rich, well drained
  - Semi dry

**Sugar Apple**
- Water logging intolerable

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**Cherimoya**
- As compared to Sugar apple
  - Ships better
  - Better flavor
  - Normally eaten as a fresh fruit

**Commercially grown in many subtropical and highland tropical regions**
**No production figures available**

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**Soursop**
- Truly tropical adaptation
- Uses
  - Some fresh and canned
  - Pulp is sold
  - Much as drinks

**Commercially suffers from low production**

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**Sugar Apple**
- Not as firm as Cherimoya
- Need to harvest before the carpels separate
- Uses
  - Mainly fresh

**Most widely grown**
- Asia, S. America, S. Mexico, Caribbean

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**Guava**

**Myrtaceae
Psidium guajava**
Production

- Grown widely in:
  - Central and south America
  - West Indies
  - India and other parts of Asia
  - Africa
- Many places it has naturalized

Plant

- Small tree (33’ or 10 m)
  - Spreading structure
  - Bark flakes off

Flowers and Fruit

- Two major commercial types of fruit

The Guava in the Americas

- Americas - light yellow skin, pink flesh, sweet, low acid

The Guava in Asia

- Asian - green skin, white flesh, sweet, low acid

Origin of Guava - Tropical America

- First evidence of domestication in Peru 800 BC
- Spanish and Portuguese explorers spread it to Africa and Asia
Adaptation

- **Soil**
  - Widely adaptable
  - pH 4.5 to 9.4
  - Somewhat salt resistant
  - Good drainage recommended but tolerate poor drainage

- **Climate**
  - Thrives in both dry and humid climates
  - Can survive only a light frost
  - Both lowland and in highlands
  - Requires 40 to 80" (1,000 to 2,000 mm) rain

Propagation

- Rooting stem cuttings most common

- Air layering and Grafting also done

Planting - higher density in Thailand

- **Americas**
  - 5-10 m square
- **Thailand**
  - 2-4 m x 5-6 m

Planting - Orchard life shorter in Thailand

- **Americas**
  - 30-40 years
  - Production decrease after 15 years
- **Thailand**
  - 4-5 years because yield decrease
  - Begin fruiting in 8 months from rooted cutting

Induction of fruiting

- Fruit on new growth from 1 year old wood
- Induce to fruit by
  - Cut off half of branch
  - Bend to horizontal position
- Fruit develop in
  - Thailand, 16-20 weeks
  - Americas, 12-21 weeks
Induction of fruiting

Bamboo structures in Thailand
Support
Ease of shoot bending

Fruit thinning

- Thin down to 1-2 fruit per shoot
- Ensure good fruit size
- Avoid breaking branches

Fruit bagging

- Done in Asia
- Two bag system
  - Inside, plastic bag, fruit fly protection
  - Outside, newspaper, sunburn protection

Fruit yield and harvest

- Thailand
  - 90% fresh
- Americas
  - Commonly cooked/processed
    - Canned
    - Paste
    - Jelly
    - Juice

Harvested Guava Fruit in Thailand

Passion fruit

Passifloraceae
Passiflora edulis
Passion flower
Passifloraceae
Passiflora
various species

Plant
- Perennial climber
- Up to 15 m (50')

Flower and fruit
- Flowers
  - Solitary, showy, incompatible
  - Current season growth
  - Flowers throughout year
- Fruit
  - Berry
  - Mature in 8-12 weeks

Origin of Passiflora edulis
Purple passionfruit originates from southern Brazil, northern Argentina, and Paraguay
The origin of the yellow passionfruit is not known

Adaptation
- Subtropical to Tropical Highland Climate
  - Needs highland climate for good flowering and fruiting
    - Cool winters (5 C; 41 F), no frosts
    - Warm summers (14 to 24 C; 57 to 75 F)
  - Yellow passionfruit is more tropical
  - Rain
    - 760-1,200 mm per year
    - Poor set if rain during flowering
  - Poor tolerance to wind - requires trellis
- Soil
  - Medium texture
  - pH 6.5 - 7.5
  - Well drained

Production
- Americas
  - Brazil, greatest producer of juice
  - Colombia, Ecuador, Peru
- Africa
  - South Africa
  - Kenya
- Asia
  - New Guinea
  - Taiwan
  - India
  - Sri Lanka
- Australia
- Hawaii
Propagation

- Seed propagation
  - Usually done by seed
  - Seedlings can be used for rootstock
- Vegetative propagation
  - Layers or rooted cuttings
  - Grafting
    - Maintain hybrids
    - Use rootstock resistant to nematodes and disease

Planting

- Spacing
  - 3-6 m between plants
  - 2-5 m between trellis rows
- Training and Pruning
  - Two wire fence trellis
  - Train leaders to wires
  - Periodically tip back laterals

Cultivation and fruiting

- Fruiting
  - Begins in 15-18 months
  - Productive life 4-8 years
  - Yield, 3-30 MT/ha
- Needs cross pollination for good production
  - Pollinators: bumble bees and hummingbirds

Harvesting

- Harvest
  - Picked from ground daily (ripe fruit fall)
  - Picked from vines 1-3 times/week
  - Expensive to harvest
- Fruit products
  - Mainly juice (30-40% yield)

Plant

- Slow growing, long lived tree
  - Elegant pyramidal shape
  - 60 - 100’ (18 - 30 m)
- Strong, wind resistant
- Bark
  - Rich in chicle - a white, gummy latex
  - Base for chewing gum

Sapodilla

Sapotaceae
Manilkara
zapota
Flowers and Fruit

- **Flowers**
  - Small and bell like
  - 3 sepals/petals

- **Fruit**
  - Round to conical
  - 2-4” (5-10 cm) wide
  - Skin - rusty brown, scurfy
  - Immature
    - Hard, gummy
    - Very astringent (tannins)
  - Flesh
    - Yellowish to reddish brown
    - Grainy to smooth
    - Sweet flavor like a pear
    - 0-12 seed

Origin of Sapodilla

- Originated in Yucatan and surrounding areas
- Cultivated in Central America since ancient times
- Taken to Philippines early in Colonial period

Production

- Wild trees in Mexico (Tabasco, Chiapas, Yucatan)
  - Tapped for chicle gum
- Tree cultivated for fruit throughout the tropics

Adaptation

- Not strictly tropical
  - Mature tree can withstand 26 F (-3C) for several hours
  - Young tree can be killed by 30F (-1C)
- Soil
  - Adapted to calcareous soils
  - Good drainage needed
  - Drought resistant
  - Salt resistant

Propagation

- Seed
  - Germinate readily
  - Fruit in 5-8 years
- Vegetative propagation
  - Grafting
  - Air layers (fruit in 2 years)
Planting

- Spacing
  - 35-40 feet (Morton)
  - 15-20 feet in India (Storey)
  - 30 feet in poor soil

Cultivation and fruiting

- Fruits mature 4-6 months after flowering
- Fruiting season
  - In tropics, almost continuously
  - Mexico
    - Peak harvest is Feb-April and Oct-Dec
  - Florida
    - Harvest from May to Sept
    - Peak in June and July

Harvesting - Major by product

- Chicle
  - Was chewed by the Mayans
  - Tapped from wild and cultivated trees
  - Introduced into the USA in 1866
  - Commercialized by incorporating flavors
  - Peak production in 1930
  - Now replaced or diluted with other latexes or synthetic gums

Sapote

Sapotaceae
Pouteria
sapota

Plant

- Tree
  - 60-100’ (18-30m)
  - Variable tree shape
  - Deciduous or evergreen

Flowers and Fruit

- Flowers
  - Small flower clusters (6-12) form in axils where leaves have fallen

- Fruit
  - Round to elliptical
    - 3-9” (7.5-23 cm)
    - 0.5-5 lbs (0.2-2.3 kg)
  - Rind, brown, leathery
  - Flesh
    - Salmon pink to red
    - Soft
    - Sweet, pumpkin-like flavor
Origin of Sapote
Lowlands of southern Mexico and northern Nicaragua

Adaptation
- Tropical to near tropical climates
  - Elevation up to 2,000’ (610 m)
  - Cold sensitive - defoliation and death
  - Rain
    - 70” (1,780 mm)
    - Intolerant of drought
- Soils
  - Best growth - Deep clay and clay loam
  - Tolerates a wide range of soils
  - Sensitive to waterlogging

Production
- Mainly cultivated in Central America and tropical South America

Propagation
- Seed propagation
  - Seed lose viability quickly
  - Only for rootstock
  - Seedlings are variable and slow to bear (8-10 years)
- Vegetative propagation
  - Budding and grafting
  - Bear in 1-4 years

Cultivation and fruiting
- Spacing
  - 25 to 40’ (7.5-12 m)
- Time to bear fruit
  - Grafted trees bear in 1-4 years
  - Fruit well for 100 years

Harvesting
- Maturity determination
  - Difficult
  - Reddish tinge
  - Sample fruit on tree and check flesh color
- Harvest
  - By hand
  - Picking pole with cutter
Any Questions?