Coffee

Family - Rubiaceae
Genus - Coffea
Species - arabica and canephora

Two Types of Coffee
About 90 Coffea spp in Africa

Arabica, C. arabica
- Medium size tree
- 14-20' tall
- Medium vigor
- Leaves: Smaller, Thinner
- Seedlings uniform
- Tetraploid, self fertile
- Ethiopia highlands: >1600m
- 15-24 ºC
- 1300 mm
- Best quality
- Susceptible to rust

Robusta, C. canephora
- Medium to large tree
- Up to 32' tall
- Vigorous
- Leaves: Larger, Thicker
- Seedlings variable
- Diploid, self incompatible
- Rain forest of Congo basin: <750m
- 24-30 ºC
- 1550 mm
- Less flavor, acidity
- Resistant to rust

Distribution of Cultivated Coffee

World Coffee Production

Brazil
- 21.1%, arabica
- Only country with frost possibility in coffee zone

Colombia
- 13.9%, arabica

Indonesia
- 7.3%, robusta

Other important producing countries
- Vietnam, Mexico, Ethiopia, India, Guatemala, Ivory Coast, Uganda

Major Consumers

- High proportion imported by developed countries
  - USA: 23%
  - EEC: 39%

The Seed of the Fruit is the Economic Part

- A Drupe like a Peach
- Both begin bearing in 3-4 years
- Time to mature fruit:
  - Arabica: 7-8 months
  - Robusta: 11-12 months
- Productive for 20-30 years
- Both need pruning for best production

The Coffee Fruit is called a Cherry

- Exocarp
  - Red skin
- Mesocarp
  - Sweet pulp
- Endocarp, hull
  - Testa (silvery)
  - Bean (embryo and cotyledons)

Coffee Tree Growth Cycle

- Dry and/or cool season
  - Floral initiation
  - Reduced vegetative growth
- Wet season
  - Flowers open, fruit set and begin development
  - Active vegetative growth
- Dry and/or cool season
  - Fruit ripen
  - Flower buds initiate
  - Reduced vegetative growth

Coffee Tree Growth Habit

- Orthotropic stem
  - Erect growth
- Plagiotropic stems
  - Horizontal secondary stems growing off of orthotropic stems
  - These are the fruiting wood


Coffee Farmers

- Grown under many conditions
  - Plantations and smaller farmers
  - Under shade and in full sun
  - Monoculture and mixed farming systems

Coffee Production

- Propagation
  - For arabica
    - Most is done by seed
  - Clonal propagation
    - Hybrids
    - Robusta types

Coffee Production

- Planting
  - Slightly acid (pH 5.2 to 6.3) well drained soil
  - Beginning of wet season
  - Vertical position or 30° angle
  - Spacing - need light for fruit ripening
    - Arabica, 1350 trees/ha
    - Robusta, 900-1000 trees/ha
  - Time to fruiting
    - Take 3-4 years to obtain mature plant
    - Fruit on year old wood

Shade and Coffee Production

- Both species are understorey trees
  - Well adapted to shade
  - Initially coffee was planted under shade
  - Small holders may use mixed farming
  - Later unshaded plants were shown to produce higher yields

Shade and Coffee Production

- Training/Pruning objectives
  - Maximize # plagiotrophic stems (fruiting wood)
  - Shape trees
    - Maximize use of space
    - Ease of management
  - Maintain open tree to allow good light penetration
  - Minimize biennial bearing
  - Remove diseased and dead wood

Conclusion:

- High input system - better with fertilizer
- Low input system - not as essential
Single Stem Training
(Central leader)

- Cut back orthotropic stem
  - Encourages plagiotropic stem formation
- Repeat for 3-5 years
  - With each cycle the tree gets bigger
  - Lower limbs die due to lack of light
- Rejuvenate after 3-5 years
  - To reduce size of tree
  - Cut back to 40-50 cm height

Multiple Stem Training
(Modified Central Leader)

- Leave 2-8 orthotropic stems
- Pruning
  - Encourages orthotropic stem formation
  - Select several orthotropic stems to be new leaders
  - Eliminate growth in center of tree
- Rejuvenation every 4-6 years
  - Need to lower fruiting surface
  - Allow basal suckers to grow

Cutting back orthotropic stem
- Encourages plagiotropic stem formation
- Select one orthotropic as new leader
- Repeat for 3-5 years
  - With each cycle the tree gets bigger
  - Lower limbs die due to lack of light
- Rejuvenate after 3-5 years
  - To reduce size of tree
  - Cut back to 40-50 cm height
Multiple Stem Training
(Modified Central Leader)

- Rejuvenation every 4-6 years
  - Allow suckers to grow
  - Remove old branches
  - Start with "lung"
  - Once suckers begin to grow, replace "lung"

Harvest

- Most done by hand
  - Ripe berries only
  - Pick every 8-10 days
- In Brazil, allow cherries to dry on tree
- Machine harvest in Brazil
  - Oscillating fingers
  - 7-9% immature fruit

Disease and Pests Problems

- Losses due to diseases
  - Africa 15%
  - Asia 15%
  - S. Am. 12%
- Coffee rust (Hemeleia vastatrix)
  - History
    - First in Sri Lanka in 1880
    - Now throughout world
  - Control
    - Robusta hybrids resistant
    - Less serious above 1700 m
    - Cu fungicides
- Coffee Berry Disease (Colletotrichum)
  - Cause berry rot

Disease and Pests Problems

- Losses due to pests
  - Africa 20%
  - Asia 15%
  - S. Am. 15%
- Coffee Berry Borer
  - History
    - Originate in Africa
    - Now throughout world
  - Damage
    - Larvae feed on bean
  - Control
    - Berry removal
    - Chemicals
    - IPM
- Monkeys, birds

Coffee Processing

Bean Processing done on the Farm

Wet Method

- Start on Harvest Day
  - Separate trash and defective berries by flotation
  - Good berries are depulped same day
- Fermentation
  - Only to remove mucilaginous covering
  - Excessive heat destroys flavor
Wet Method
- Washed
  - Water under pressure
- Dried - spread out to dry
  - Sun
  - Artificial heat
- Best quality
  - Gives coffee that is cleaner, brighter, fruitier, better acidity

Dry Method (Natural Method)
(Most traditional and least expensive)
- Drying
  - Initial drying done on trees
  - Spread on concrete, tile or matted surface
  - 2" thick and constantly raked
  - 3-15 days until specific moisture
  - Pergamino is dry and crumbly

Dry Method
(Most traditional and least expensive)
- Remove pericarp
  - Mortar and pestle or machine
- Chaff removed via winnowing and picking
- Sorted by size, shape, density and color
- Packed in 60 kg bags for processing

Industrial Processing
(Usually by importing company)
- Grading process
  - Redry and clean the parchment beans before using
  - Remove testa (hulling and polishing)
  - Sort on size and density
- Roasting (370°F to 540°F)
  - Removes moisture
  - Light roast lose 3-5% moisture
  - Dark roast lose 8-14% moisture
  - Time (up to 30 min) determines flavor
    - Decreasing the amount of
      - Chlorogenic acid
      - Trigonelline
- Grinding
  - Coarse to medium (600–1100 µm)
  - Fine grinds (Automatic percolators)
    - Home percolators
    - Europe (400–500 µm)
    - USA (600–700 µm)
Industrial Processing
(Usually by importing company)

- **Instant Coffee**
  - Extract soluble solids, volatile aroma and flavor with water

- **Drying**
  - Drum drying - poor appearance
  - Spray drying - loses flavor volatiles
  - Freeze drying - best product
    - Best retention of flavor
    - Produces granules
    - No evaporation so no loss of flavor
    - Coffee oil for head space aroma

Any Questions?