**Durian**

*Bombacaceae*  
*D. zibethinus*

*King of Tropical Fruit*

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**Plant**

- Large tree  
  - 90-130' (27-40m) tall
  - Erect and pyramidal
  - Rough peeling bark

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**Flowers**

- Cymose clusters  
  - 3-50 flowers  
  - Leafless nodes
  - Mature branches
- Large flowers

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**Flowers**

- Cymose clusters
- Large flowers
  - Nocturnal flowering
  - Fragrant with nectar
  - Bats and moths
  - Range of self incompatibility
    - Selfed fruit set - 1%
    - Crossed pollinated fruit set - up to 60%

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**Fruit borne on old branches**

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**Fruit is large**

- Size
  - Up to 18 lbs (8 kg)
  - 6-12' (15-20cm) long
  - 5-6" (12-15 cm) wide

- Rind
  - Stout, sharp spines
  - Handle with gloves
Fruit is odoriferous but delicious

- Odor
  - “Garlic, Limburger cheese and some spicy sort of resin”
  - Some odorless cultivars

- Flesh
  - Soft custard-like texture
  - “Concoction of ice cream, onions, spices, and bananas”
  - People become fanatics in their enthusiasm for the durian

Origin of Durian

- Originated in Sumatra and Borneo

Adaptation: Tropical lowland tree
(best within 12° from equator)

- Temperature
  - Ideal 27-30°C
  - Usually lower than 600 m (2000’)
  - Tolerate high temperatures
    - Up to 46°C (112°F)
  - Defoliate if below 10°C (50°F)

- Moisture
  - 75-80% relative humidity
  - 1,500 to 2,500 mm per year
  - 9 to 11 wet months
  - Flowers after the dry season

- Soil
  - Deep alluvial or loamy soil

Production

- Mainly produced in Asia
  - Malaysia - 380,000 MT
  - Thailand - 750,000 MT
  - Indonesia - 230,000 MT

Propagation

- Seed propagation
  - Short period of viability
  - Seedling trees are variable
  - Begin to fruit in 5 to 21 years (9-12)

- Clonal propagation
  - Rooting of cuttings and air layering is poor
  - Patch budding, fruit in 3-4 years
**Planting**

- **Spacing**
  - 30-40' (9-12m) apart
- **Precocity**
  - Grafted - 3 to 4 years
  - Seedlings - 9 to 12 years is common

**Fruiting**

- **Fruit**
  - 3.5 to 4.5 months to develop
- **Harvest season depends on weather patterns**
  - Flowers after the dry season
  - One or two peak harvests per year
  - Most varieties ripen with 6-10 weeks causing an abundance of fruit

**Harvesting**

- **Yields**
  - 5-7 MT/ha
- **Harvest techniques**
  - Pick before fall
  - Pick up fallen fruit
    - Rural areas
    - Falling durians can cause injury

**Marketing**

- **Fresh fruit is highly perishable**
  - 5 to 6 days
- **Products**
  - Fresh fruit
    - Whole or in segments
  - Dried for local use and export
  - Canned in syrup

**Carambola**

- **Oxalidaceae**
- **Averrhoa carambola**

**Plant**

- **Tree**
  - Short trunk
  - Many branched
  - 20-30' (6-9m)
- **Leaves**
  - Compound
**Flowers**
- Small
- White or purplish
- Short racemes

**Fruit**
- Oval or elliptical
- Yellow or pale golden brown
- 3-5 " long
- 3-5 longitudinal ribs
- Clear watery pulp
- Flavor: Astringent when green, Sour to mildly sweetish when ripe
- "Sweet" types have 4-9 brix
- Aroma like quince

**Origin of Carambola**
- Originated in Sri Lanka and the Moluccas
- Cultivated in Southeast Asia and Malaysia for centuries

**Production**
- **Asian production**
  - India
  - Southern China
  - Taiwan
- **Florida**
  - Recent increase in production

**Adaptation**
- **Tropical-subtropical**
  - Short periods of 27°F (-2.8°C)
- **Moisture**
  - Need even distribution of rain
  - Australia: best if 70" (1800 mm)
- **Soil**
  - Can grow in wide range of soils
  - Good drainage needed
  - Sensitive to waterlogging

**Propagation**
- Widely done by seed
  - Viable for only a few days
  - Seedlings are variable
- **Clonal propagation**
  - Air layering - slow
  - Various grafting techniques
**Planting**
- **Spacing**
  - 20-30' (6-9m)
- **Precocity**
  - Grafted trees fruit within 10 months

**Harvesting**
- **Precocity**
  - Grafted trees fruit within 10 months
- **Yield**
  - 100 - 300 lbs (45-135 kg)/tree

**Uses**
- **Fresh consumption**
  - Out-of-hand
  - In salads
  - As garnish
- **Used in cooking in Asia**
  - Puddings and tarts
  - Stews and Puddings
- **Health concerns**
  - High levels of oxalic acid (0.5 mg/100 mL juice)
  - Inhibit Calcium absorption

**Tamarind**
- **Leguminosae**
- **Tamarindus indica**

**Plant**
- **Slow growing large tree**
  - 80-100' (24-30m) tall
  - Spread of 40' (12m)
- **Wind resistant**

**Flowers**
- **Inconspicuous**
- **Inch wide**
- **5 petals**
- **Small racemes**
**Pods, irregularly curved**
- 5-10 cm (2-4”)
- Grayish brown with 1-10 brown seed
- Pulp - brown and sticky

**Origin of Tamarind**

- **Savannas of tropical Africa**
  - Grows wild throughout Sudan
- **Moved to India long ago**
  - Often reported as native to India
  - Well known in Egypt and Greece in the 4th century BC
- **Introduced into tropical America much before 1800**

**Production**

- **Major producing countries**
  - Americas
    - Mexico - 4,000 ha
  - Belize
  - Guatemala
  - Northern Brazil
- **Asia**
  - India - 250,000 MT
  - Northern Malaysia

**Adaptation**

- Native to tropical savannas of Africa
- **Soil**
  - Tolerates a diversity of soils
  - Withstands salt spray
  - Good drainage essential
- **Temperature**
  - Older trees can survive light freezes
  - Lowland tropics (up to 600 m)
- **Moisture**
  - Dry weather essential during fruit development

**Origin**

- **Propagations**
  - Traditionally
    - Seed planted in the field in place
  - More recently
    - Seedlings grown in nursery
  - **Future**
    - Rooted cuttings
    - Grafting
**Planting**
- **Spacing**
  - 33-65' (10-20m) - depends on soil fertility
- **Precocity**
  - Begin to fruit in 4-5 years in Mexico
  - In India it may take 10-14 years
- **Productive life**
  - 50-60 years
  - After this productivity declines
  - May live to 200 years

**Fruiting**
- **Fruit development**
  - 203 days until begin to dehydrate
  - Full ripeness at 245 days
  - 50% previous moisture content
- **Harvest**
  - Can leave for another 6 months
  - Dry down to 20% moisture

**Harvesting**
- **Yield**
  - 330 to 500 lbs (150-225 kg) fruit/tree
- **Fruit composition**
  - Pulp 30-55%
  - Shells and fiber 11 - 30%
  - Seeds 33-40%
- **Preservation**
  - Shelled
  - Preserved in sugar or salt

**Uses of Tamarind**
- **Main product is the seed pulp**
  - Ingredient in chutneys, curries, sauces,….
  - Sugared into confection
  - Drinks
- **Seeds**
  - Can be eaten
  - Various industrial uses

**Any Questions?**

**Homework**
(15 points)
- Find food products that use the following
  - Coconut oil
  - Palm oil
  - Palm kernel oil
- Need to find 5 items for full credit
- Due on Monday, November 3rd
<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
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<tbody>
<tr>
<td><strong>Transportation</strong></td>
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<tr>
<td>Airfare</td>
<td>$650</td>
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<tr>
<td>Bus</td>
<td>$140</td>
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<tr>
<td><strong>Lodging</strong></td>
<td></td>
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<tr>
<td>Hotels</td>
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<tr>
<td><strong>Food</strong></td>
<td>(paid as you go)</td>
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<tr>
<td><strong>Entrance visa</strong></td>
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</tr>
<tr>
<td><strong>Airport tax</strong></td>
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<tr>
<td><strong>Insurance</strong></td>
<td>$20</td>
</tr>
<tr>
<td><strong>Coordination fee</strong></td>
<td>$100</td>
</tr>
<tr>
<td><strong>TOTAL COST</strong></td>
<td><strong>$1,360</strong></td>
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