

**Lecture 17**  
**Tropical Beverage Crops—Coffee**  
**Family: Rubiaceae**



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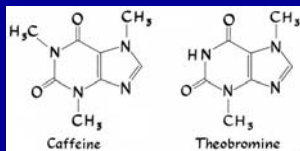
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Major beverages (alcoholic and non-alcoholic) are consumed not only to quench thirst but to provide a mild stimulant or “lift.”

Nonalcoholic beverages such as coffee, tea, mate, cocoa do this by the presence of an alkaloid (caffeine or theobromine—which differ by a mere methyl group).

Typically their taste is an acquired one; thus none of these major beverages are initially liked by children unless sweetened.

Alkaloids: Cyclic Nitrogen Compounds



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**History**

Coffee, traditional morning “eye opener,” is widely consumed as a pick-me-up break the world over in various ways including steeped, steamed, or boiled.

The plant originated in Africa, and entered Arabia (Yemen) from raids into Abyssinia now Ethiopia (Mocha, a slang name for coffee is derived from the city of Mocha (*Al Mukha* in Arabic) in southern Yemen on the Red Sea.

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## Tropical Horticulture: Lecture 17

African natives chewed leaves and berries as a stimulant.

Coffee was grown as early as the 7<sup>th</sup> century in Arabia and neighboring countries.

Ground roasted “beans” (the seeds) are steeped in water to make the familiar beverage which is usually consumed hot.

Coffee was introduced into Southern Europe by Arab traders in the late Middle Ages but was not widely known in Europe until sea routes to the East were opened by the Dutch and English in the 17<sup>th</sup> Century (1615).

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Coffee houses were established in England, the Netherlands and elsewhere in Northern Europe about 1650, later in the American colonies.

Coffee houses became social, literary, and political centers (Lloyds of London originated in a coffee house).

Interestingly, this is being repeated today as interest in espresso, coffee, cappuccino, etc. has become a new fad in American culture.

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Arabia remained the sole source of supply until the Dutch introduced *C. arabica* into Ceylon (Sri Lanka) in 1658 and Java in 1699 (now the main island of Indonesia).

Another slang name “java” for coffee still used is based on this derivation (a famous grill in the old Fowler Hotel in Lafayette was called the Java shop).

Coffee moved to the New World (Martinique) from Java via Paris.

Presently the main center of production is the New World, particularly Brazil and Colombia.

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### Per Capita Consumption

Main consumption is still in Scandinavia particularly Sweden (8 kg/capita).

Hence, a fictitious Mrs Olsen, a sweet busybody, was long used by Procter and Gamble in the ad campaign for their Folger's brand of coffee.



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Other major consuming countries are USA, France, Germany.

Until recently UK and former colonies were low coffee consumers preferring tea but coffee consumption is increasing.

Interestingly, per capita consumption of coffee has shown a decrease because the present generation X prefers soft drinks—which also contains caffeine—even for breakfast.

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### 2001 World Production

Continent	1000 tonnes	Chief countries
World total	7,044	
Africa	1,160	Ivory Coast (280), Ethiopia (228), Uganda (197)
North America	1,293	Mexico (330), Guatemala (276), Honduras (206)
South America	2,742	Brazil (1780), Colombia (560), Peru (158)
Asia	1,765	Viet Nam (800), Indonesia (377), India (301)
Oceania	84	Papua New Guinea (84)

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# Tropical Horticulture: Lecture 17

## Botany

Over 25 to 100 species native to tropical Africa, but some in SE Asia.

Related species are *Cinchona* spp., source of quinine.

### Four important species of *Coffea*:

*C. arabica*, 90% of world's coffee; self fertile; 6–8 months from bloom to ripening.

#### Two subspecies:

var. *arabica* common in Brazil and East Africa, dominant type in Asia

var. *bourbon*, from Reunion, formerly Bourbon, an island 400 miles east of Madagascar.

A high altitude coffee.

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### *C. canephora*

Known as Robusta coffee; 9% of world's coffee; 9–11 months from bloom to ripening; self sterile; indigenous to African equatorial forests and thus a lowland coffee; vigorous growth, productivity and disease resistance.

Quality inferior to *C. arabica* in flavor and aroma, but seems to be increasing with production of instant coffees.

### *C. excelsa*

Vigorous; ripens 11–12 months from bloom.

### *C. Liberica*

Ripens 14 months from bloom; 1% of world's coffee.

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Arabica–robusta hybrid

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# Tropical Horticulture: Lecture 17

*Coffea* represents understory vegetation of tropical forest.  
Best adapted 4500–6000'; it is grown in full sun in Brazil because not enough moisture for shade trees.  
The tree is 15 to 40' when mature but some dwarf types.  
Adapted from 28°N to 34°S; sea level to 7000'.  
Rainfall is critical.  
Average annual temperature of 70°F.  
Frost and cold can damage coffee; freeze can kill.



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### Shade

Used in most areas, probably important to prevent temperature fluctuations and to provide protection from winds and drought.  
However, higher yields are obtained without shade.  
Benefits of shade:  
Extends life of tree  
Prevents overbearing  
Annual cropping  
Reduce temperature of air and soil  
Reduce hail  
Reduce evaporation and transpiration  
Organic mulch from leaves  
Protects organic matter of soil

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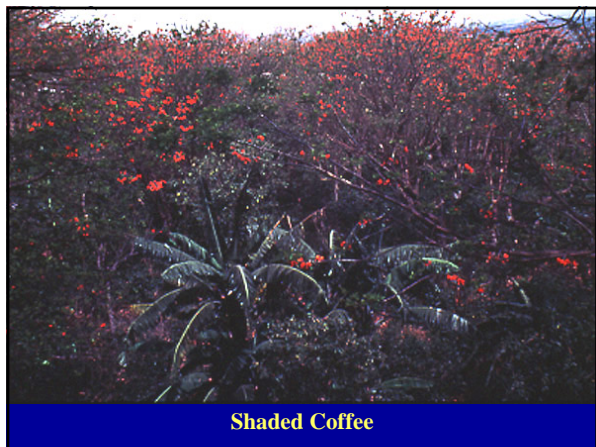
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# Tropical Horticulture: Lecture 17

## Flowering

Rainfall is important for flowering.  
Requires 30 to 100" per year, usually 40 to 70".  
Definite wet and dry needed to bring plant to flower and rest.  
Without rain there is no flowering.  
However constant rain gives continual flowering and no peak harvest season.  
Sao Paulo, Brazil is ideal for coffee (Savanna climate).  
8-14" of rain per month for 5 months  
2-3" of rain per month for 3 months  
0" of rain for the next 3 months (harvest season).

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## Culture

Propagation by seedlings is still carried out either by direct planting (old system) or by transplants.  
Clonal propagation by grafts or cuttings is more expensive but use of superior genotypes give higher yields.  
At the present, vegetative propagation using tissue culture via somatic embryos is being investigated by the French (Nestle).  
Clonal propagation is more expensive but produces more homogenous plantings.

## Pruning

Renewal pruning can be carried out to control shape and height of the tree and to renew productive wood.

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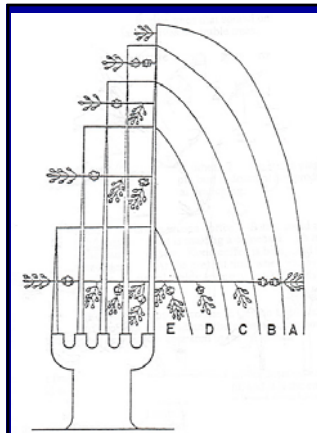
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- A. Vegetative growth, current year
- B. Main crop on previous years growth
- C. Lateral growth on 3 year old wood
- D. Fruit on laterals
- E. Lateral growth on old verticals

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**Morphology**

Coffee is dimorphic composed of two types of growth: spreading (plagiotropic) or upright (orthotropic).

Cuttings and grafts from vegetative uprights give upright growth; cuttings from horizontal (plagiotropic) growth give trees that sprawl on the ground and are worthless.

This is the reason seed propagation gives desirable trees.

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**Plagiotropic Growth**



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Coffee may be topworked by grafting reproductive branches (plagiotropic) on the seedling rootstocks 2.5–3 m (7–10').

In each leaf axil there are two leaf buds, one above the other.

The top bud is plagiotropic and produces horizontal growth; the bottom orthotropic bud is dormant and produces uprights.

Dominance of apical bud assures horizontal branching.

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# Tropical Horticulture: Lecture 17

## Yields

Highest yields (2000 lb/acre) are found in Hawaii (Kona coffee).

Coffee could not compete in Hawaii because of high labor costs, but is making a comeback with resurgence of interest in gourmet coffee and the tourist industry.

Kona coffee is being sold at \$10–15/lb to tourists and cannot meet demand.

At the present time when you buy Kona coffee it is diluted with cheaper coffees.

In Brazil yields are usually 400 lb/acre.

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## Diseases

Rust due to *Hemileia vastatrix* has caused collapse of coffee in Ceylon and Java.

This disease is not as serious with robusta coffees if shaded and therefore *C. canephora* is replacing *C. arabica* in some areas.

Rust has now appeared in the Americas.

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Coffee in bloom

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Tropical Horticulture: Lecture 17



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# Tropical Horticulture: Lecture 17

## Processing

The ripe coffee "berry" (a fruit) consists of seed covered by a silvery testa (silverskin), a parchment layer, flesh, and skin.

The seed is mostly endosperm, and it is the endosperm not the embryo that produces the coffee flavor.

Note that all the layers must be removed in processing to produce the seed.

Seed consists mainly of green, corneous endosperm with a small embryo near the base.

Dried seeds after removal of silver skin provide the coffee beans of commerce; 5-6 lb of cherry (whole fruit) provides ~1 lb of clean coffee; 1,000-dried seeds/lb.

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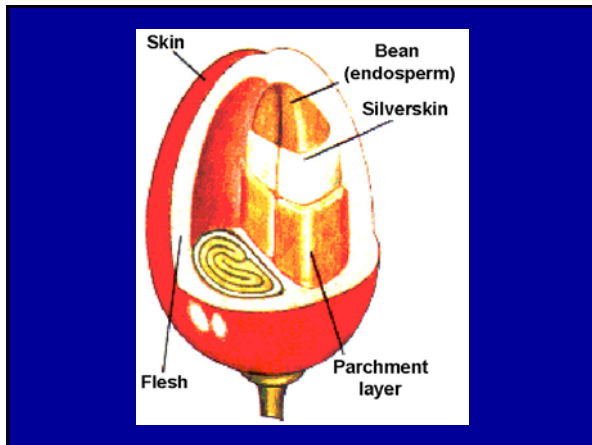
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## Two main types:

Wet processing (most common)

This requires abundant water.

1. Flotation: Defective berries are first separated by floatation, good ones sink.
2. Pulping and separation: Ripe berries run through machines which pull off skin and most of the flesh.

This must be done within 24 hours with red ripe fruit to prevent overheating and tainting of "beans" from rotting pulp.

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- 3. Berries from separator are washed
- 4. Put in fermentation tanks to remove flesh adhering to parchment coat (18–24 hr) up to 80 hr if elevation is high and temperatures are cool.
- 5. Washing
- 6. Curing
- 7. Hulling or picking off parchment layer and silverskin by machinery.
  - Seeds become shiny after polishing (removal of silverskin).
  - Grading by weight and size.
  - Often picked over by hand to remove stones, black beans etc.
  - Now electronically sorted in advanced operations.

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### Dry Processing

- Fermentation step is eliminated.
- All stages of berries are dried in heaps (15–25 days) and dehusked.
- Often moistened to remove silverskins.

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### Economics

- Economy of coffee has been disturbed by boom and bust economies.
- Gluts cause low prices; government usually buy and store coffee to protect prices but system collapse when stored coffee gets to high levels resulting in dumping.
- Rust is now a major problem causing shortages and high prices.
- The interest in decaffeinated coffees has increased the importance of African robusta.

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