


Tropical Horticulture: Lecture 29

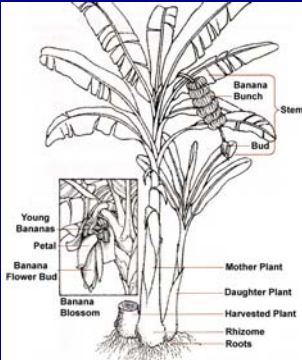
Lecture 29
Banana & Plantain
Musa ×paradisiaca, Musaceae



The plant is a gigantic herb basically consisting of a pseudostem made up of leaf sheaths with an inflorescence pushing through the sheaths.

The banana is a basic staple in tropical countries and was consumed before recorded history in Southeast Asia.

There are basically two kinds: banana (consumed mostly as fresh fruit) and plantain (cooking banana).



Uses

Fresh fruit—In some African countries consumption is 4 to 4.5 kg/capita/day. In western Europe and US typically 1–2 bananas/capita/week—25 g/day.

One of the least expensive fruits consumed. Everyone's second favorite fruit.

Cooked (especially starchy types)

Dried

Banana flour

Buds eaten

Green leaves used as plates and wrapping

Cordage for fiber

Inks (sap produces an indelible stain on fabrics)

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History

Cultivated in southeast Asia in antiquity; known by reputation to Theophrastus.

Banana introduced to Mediterranean region in the year 650.

Bananas may have moved to Africa by Arab traders in first century or from India via Southern Arabia and Ethiopia.

Many cultivars in Uganda suggest long history, unlikely all passed through Ethiopia.

Clones first established in New World were 'Silk Fig,' and 'French Plantain'.

These were described by Linnaeus as *M. paradisiaca* and *M. sapientum*.

'Gros Michel' was introduced in the 19th century.

Banana trade from West Indies centered around United Fruit Company originally Boston Freight Company; brought about a banana bonanza and altered the politics of Central America (development of Banana Republics).

There are now two major companies, United Fruit and Castle & Cook (formerly Standard Fruit).

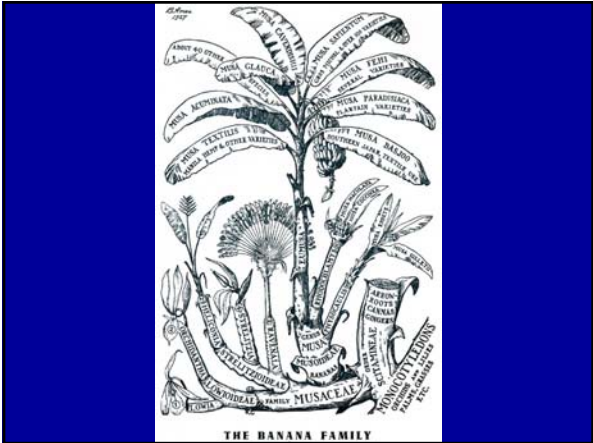
Musaceae Taxonomy

Genus	Chrom no.	Section	Distribution	No. species	Uses
<i>Ensete</i>	9		W. Africa, New Guinea	7-8	Fibers, vegetation (soft portions of stem)
<i>Musa</i>	10	Australimusa	Australia to Philippines	5-6	Fiber (Abacá)
	10	Callimusa	Indochina, Indonesia	5-6	Ornamentals
	11	Eumusa	S. Indian, Japan, Samoa	9-10	Fruit, fiber, veg
	11	Rhodochlamys	India, Indonesia	5-6	Ornamentals

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Musa rosacea
(*Musa balbisiana*)



THE BANANA FAMILY

Australimusa—Manila hemp or abaca (*Musa textilis*)
 One cultivar called 'Fe'I' has edible fruit.
 Callimusa—*M. coccinea* is an ornamental.
 Eumusa—The largest section gave rise to edible banana. The two important species that gave rise to the modern banana include
M. acuminata (A genome=AA)
M. balbisiana (B genome=BB).

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Classification of Cultivars is Very Difficult

Most edible bananas thought to derive from the above two species.

Scoring method is based on the contribution of the two species using 15 morphological characters, scoring 1 (*acuminata*-like) to 5 (*balbisiana*-like).

Thus a score of 15 (1 × 15 characters) would be considered pure *acuminata* and a score of 75 (5 × 15 characters) would be pure *balbisiana*.

Polyploid makes these results difficult to interpret. Banana and plantains were found to be diploid ($2n$), triploid ($3n$) and rarely tetraploid ($4n$).

In general diploids have stiffer leaves and petioles.

Triploids had stiffer leaves than tetraploids.

The triploids and tetraploids were larger and more robust than diploids.

Note also that wild diploid species are seeded.

All the cultivated edible bananas are seedless.

The characters contributing to seedlessness include triploidy and sterility.

Seedy bananas used for wind breaks



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Ploidy in Bananas

Using the genomic symbols (A and B) and considering ploidy, we can classify *Musa* as either:

AA (diploid), AAA (triploid), & AAAA (tetraploid)
BB (diploid), BBB (triploid), & BBBB (tetraploid).

The following hybrids have also been identified between these species:

AB—'Apple' banana
AAB—Plantain, 'Silk Fig'
ABB—'Blugoe'

Banana Types based on Genomic Formulas

AA

'Sucrier' (synonym is 'Lady Finger').

Large vigorous plant, very tall, small cluster.

Resistant to Panama wilt, susceptible to leaf spot.

This is the only important diploid *M. acuminata* type.

'Sucrier' is widely cultivated but not grown much commercially because fruit is very soft.

Fruit is very delicious and widely admired.

AAA

Centers in Malaysia but may be a secondary center in upper East Africa where extensively cultivated.

More vigorous than AA but not as hardy.

'Gros Michel' ('Bluefield').

Known as "Big Mike" this was at one time the most important banana of commerce.

A very large plant, native to Malaysia, it was widely grown in Central and South America.

It had large clusters and firm fruit but it was susceptible to Panama wilt and leaf spot.

It has now been replaced by 'Valery', a member of the Dwarf Cavendish group.

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'Dwarf Cavendish' ('Chinese' banana).

Immune to Panama wilt but susceptible to leaf spot.
'Valery', a selection of 'Dwarf Cavendish', has now replaced 'Gros Michel' in Central America.

'Giant Cavendish' has fruits that are larger than 'Dwarf Cavendish'.

Plants are taller than 'Dwarf Cavendish', and is a mutant from the 'Chinese' banana.

'Robusta', plant has medium resistance to Panama wilt but susceptible to leaf spot.

An unknown group and somewhat confusing.

'Hamakua' [Hawaiian name (syn. 'Pisang Masak Hijan' (Malaysia), 'Bungulan' (Philippines) and 'Lacatan' (Jamaica).]

Fruit matures when green.

Less hardy and tolerant to poor soils than 'Gros Michel'.

Immune to Panama wilt but not as good flavor.

Tall plant, fruit tastes similar to Cavendish types.

'Red' (petioles and midrib are red, fruit is red) and 'Green Red' (petioles pink and midrib is pink, fruits are green; originated from 'Red').

AAAA

ICT-2 ('Golden Beauty') derived from the Imperial College of Trinidad.

Only bred type that is resistant to Panama disease; derives from a cross of 'Gros Michel' × *M. acuminata*; is similar to 'Gros Michel' but tastes like Chinese banana.

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AB

Widely distributed group; high resistance to Panama wilt and leaf spot.
'Apple' banana (known in Brazil as 'Macá'—which means apple; has an apple-like flavor).

AAB

'Pisang Rajah'
Plantain subgroup:
French type (many forms)
Horn type (many forms)
These are resistant to Panama disease and leaf spot.
Large fingers, important source of food.
Note that there is no sharp discontinuity between French and Horn plantain.
'Mysore' ('Lady's Finger' in Egypt.)
Resistant to Panama disease and leafspot; 70% of the crop in India.
'Maia Maoli' (Hawaiian) probably originated in Philippines.

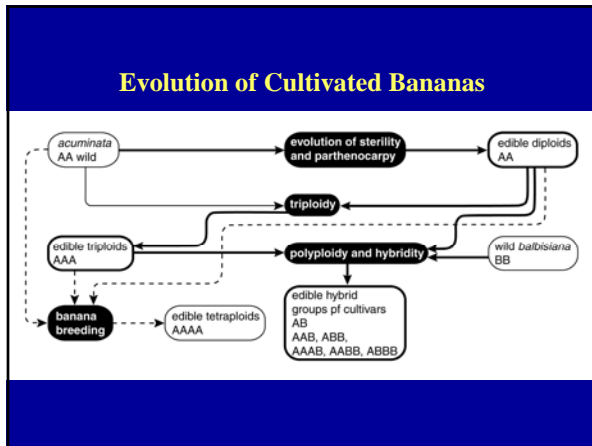
ABB

'Bluggoe' is the starch cooking banana in Samoa, Philippines, and southern India.
'Piang Awak' (Thailand)
'Ice Cream' very frosty white flesh, skin is very light.

ABBB

Only known natural tetraploid.
A type is known in Indochina.
Fruit is fibrous, spongy, but can be cooked.

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Banana Production (2001)

Continent	1000 tonnes	Chief countries
World	68,651	
Africa	7,697	Burundi (1,549), Uganda (973), Cameroon (850)
North America	7,930	Costa Rica (2,270), Mexico (1,977), Guatemala (789)
South America	16,736	Ecuador (7,561), Brazil (5,744), Colombia (1,380)
Asia	34,802	India (16,000), China (5,393), Philippines (5,061)
Europe	450	Spain (415), Portugal (30), Greece (4)
Oceania	1,037	Papua New Guinea (712), Australia (275), Samoa (20)

Plantain Production (2001)

Continent	1000 tonnes	Chief countries
World	29,121	
Africa	20,579	Uganda (9,533), Ghana (1,932), Nigeria (1,902)
North America	1,733	Cuba (380), Dominican Rep. (343), Haiti (280)
South America	5,672	Colombia (2,827), Peru (1,450), Venezuela (700)
Asia	1,134	Sri Lanka (780), Myanmar (354)
Oceania	3	Tonga (3)

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Ecology

Banana is native to the tropical lowlands, usually found up to 30° latitude, N and S.

Distribution is limited by 50 inches of rainfall (minimum) and 60°F temperature.

Subject to chilling injury and extremely susceptible to frost.

One frosty night can ruin a plantation.

However there are a few areas outside of this boundary including New South Wales in Australia, Israel, Morocco and Taiwan.

In Morocco, many bananas are now grown in greenhouses.

Two inches of rain per month are minimum level on all but porous soils.

Monthly mean temperatures less than 70°F will check growth while 80°F is more satisfactory than 70°F.

The number of dry months less than 2 inches of rain and months under 60°F will give a measure of the unsuitability of climate.

Water deficits affects fruit production.

Need 600 lb. water for every lb. of dry matter.

Thus areas less than 60 inches of rain require supplementary irrigation.

In addition heavy winds are very destructive.

Flat land ideal because of irrigation, mechanization, and cultivation.

Plantings on hillsides required terracing.

Soil factors include drainage, depth, and avoidance of toxic.

However banana is grown in many locations with different soil types.

Good soil drainage is critical.

Tropical soils lose organic matter rapidly and nitrogen tends to be deficient all of the time.

There is rather wide adaptability to pH.

Bananas are often grown under low pH but this favors the spread of Panama disease.

Basic soils give iron chlorosis but FeSO₄ corrects this.

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Spacing

A wide range of spacing is found throughout the world:
4.7 × 4.7 ft = 2000 plants/acre;
17.5 × 17.5 ft = 150 plants/acre.
Typical plantings range from 8 × 8 to 11 × 11 feet.

Factors Affecting Spacing

Type of clone, ('Dwarf Cavandish' is planted closer than 'Gros Michel')

Soil fertility (High fertility permits high population)

Pruning regime (Pruning allows higher populations)

Mechanization (Wider spacing required to accommodate machines)

Irrigation (Irrigation requires long straight rows)

Weed control (High population provides shade to control weeds. Herbicides accommodate lower populations)

Requirements for bunch size

Fruit quality (fruit abrasion caused by high density)

Propagation

Bananas are propagated by suckers, by pieces of the corm, or from tissue culture.

Suckers: Various size suckers (followers) may be used. They are known as "peepers" when very young, sword suckers when buds low on the corm bear narrow leaves, or maiden suckers (tall).

In the tropics, type of sucker is not very important but very small or diseased suckers must be avoided.

Corms: Injury to corms induces bud formation. Corms usually are disinfected to reduce soil borne diseases.

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Tissue Culture

This method of propagation is increasing to provide disease free stock.

The big problem is to reduce off types from tissue-culture induced variability.

Some variants occur with very high frequency and careful control is need to reduce their frequency.

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Cultural Practices

Deep planting gives sturdier tree.
Planting time is best carried out before wet season to give maximum growth unless irrigation is available.
Dry season, however, gives less disease.
Spring planting is the rule in the subtropics.
Roots of banana are shallow so tillage should be minimum.
Use of herbicides allows clean cultivation.

Pruning and Staking

The removal of unwanted suckers is known as pruning.
These are cut at or below ground level.
The critical management problem is to set up the follow-up plant to get the desired spread in fruiting in relation to market price or weather.
It is undesirable to get two plants giving fruit at the same time.
Staking is used to prevent blowdown.
In Taiwan government only compensates staked field after blowdown.

Oldest banana fields in Madras, India may be 100 years old.
In Uganda 40 to 60 year old plantations are not uncommon.
Honduras plantations are rarely 40 years old., most are 5 to 25 years.
In Jamaica 5–6 year old plantings are the rule in mechanically cultivated plantations, but short life are also a result of Panama wilt.

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Nutrition

Proper nutrition affected by region and field.
Early phase of growth is critical.
N always considered deficient in the tropics.

Fruit Protection

Blue plastic bags are placed around fruit stems to increase yield.
Removal of withered style suggested to prevent disease in 'Gros Michel' but may abscise naturally.
Removal of male bud may lighten bunch.

Diseases

Panama Disease (*Fusarium oxysporium cubense*)

First symptoms are a yellowing of outer leaf blades.
Symptoms from outer leaves move inward.
Cross sectional cuts of pseudostem gives red discoloration of vascular bundles.
Growth stops and plants die.
No effective chemical control.
Flooding gives some control.
Resistant cultivars are the best control system.

Sigatoka Leaf Spot (*Cercospora muscae*)

Symptoms are brown spots on the leaves which coalesce to form larger lesions.
Use of summer oils with fungicide is usual method of control.

Fusarium Stalk Rot (*Fusarium moniliforme*)

Leaves as they emerge from pseudostem are rotted, except for midrib; is confined to 'Gros Michel'.

Freckle Disease (*Microphoma musae*)

Bunchy Top Virus

Cavendish is susceptible.
Leaves become narrow, distorted and short.

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Fruit Ripening

Bananas are harvested in the green stage and ripening is controlled by temperature and ethylene.
Because of long distance shipment, proper harvest time and ripening procedures is the key factor in the commercial industry.
Ripening bananas may be held 56 to 60°F; lower temperatures cause chilling injury and discoloration of the skin.
If kept at low humidity fruit gets mealy at any temperature.

Ripening Schedule

Temperature (°F)					
Day					
1st	2nd	3rd	4th	5th	6th
68	68	68	60		
66	66	66	66	56	
64	64	64	64	60	56

Ripe bananas require 85 to 95% relative humidity (RH); green bananas require 100% RH
Ethylene treatment induce ripening.
Ripening room temperature raised to 65°F and then ethylene is released.
A cubic ft. of ethylene in 1000 ft. of space is 100 ppm.
Usually two to three applications at 24 hr intervals.

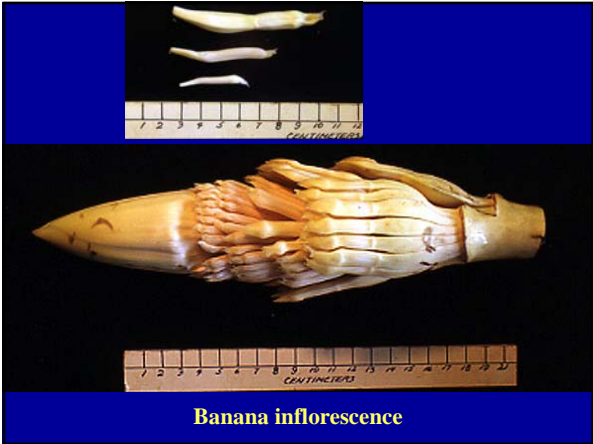
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Banana inflorescence

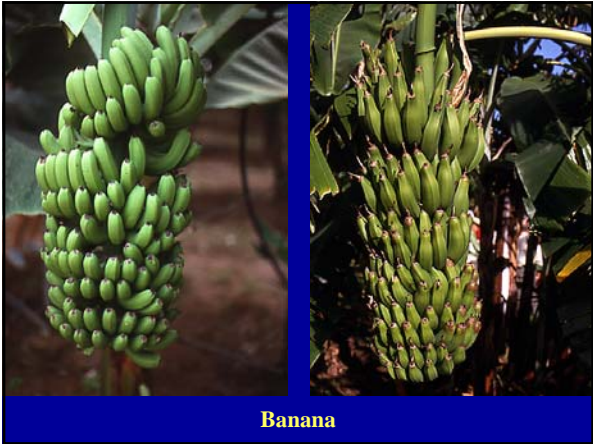


Banana flowers



Banana inflorescence

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Banana as an intercrop
