

Lecture 22 Rubber

Hevea Rubber Tree: *Hevea brasiliensis*, Euphorbiaceae



History of Hevea Rubber

A latex yielding plant native to South America (Amazon region).

There are 9 species of *Hevea*, of which *Hevea brasiliensis* is the most important.

Seeds can be eaten when boiled, oil in seeds can be used for illumination.

The native Indians of the area used the product to make dolls and balls; also used it to waterproof moccasins!

The French called it caoutchouc.

1763—French found caoutchouc could be dissolved in naphtha, suggested use in waterproofing clothing but it became tacky when warm.

1770—Joseph Priestly discovered that the material would rub out paper marks, hence the name India rubber, and now simply “rubber.”

1823—Mackintosh manufactures waterproof raincoats by coating fabric with rubber dissolved in naphtha.

1824—Hancock suggested plantation growing of rubber.

1839—Goodyear and/or Hancock discovered vulcanization; when rubber was heated with sulfur, rubber retained physical properties from 0 to 100°C. This led to rubber boom.

Interest in rubber with vulcanization process led to increased demand and exploitation of wild Hevea trees (Hevea was the native word).

Native tappers (seringuiros) hacked trees and spoiled them for later tapping.

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1870—Sir Clements Markham of India Office suggested that rubber along with cinchona (source of quinine) be obtained from tropical America and grown in Asia.

1872—James Collins reviewed rubber producing plants, published monograph entitled *Caoutchouc of Commerce*.

1873—Seeds from Brazil sent to Kew Gardens; 12 plants raised and sent to Calcutta, but failed.

1875—Second consignment of seed failed to germinate.

1876—Makham sends Robert Cross to Panama (for Castilla) and to Para, Brazil where he obtained 1000 plants of Hevea, but no plants reach the East.

At this time H.A. Wickham, an Englishman residing at Manaus (center of the rubber boom in Brazil), sent 70,000 seed from Central Amazon basin (he received 10 £ /100 seed) in an arrangement financed by the government of India.

This provided the basis for the world's rubber industry.

The seeds were sent to Kew.

Seed has short viability but produced 2899 plants.

Seedlings were sent to Ceylon and 50 plants to Singapore, and a few to Java.

1888—In Singapore there were 9 trees of the original introduction, 21 five-year old trees and 1000 seedlings. Ceylon had 20,000 seed.

H.N. Ridley, scientific director of the Botanical gardens at Singapore developed the rubber industry.

He demonstrated that Hevea was the superior rubber bearing plant, discovered excision method of extracting latex, and devised method for coagulating latex, time of tapping and retapping.

1898—Dunlop rediscovers pneumatic tires (Motor cars invented in 1885).

(Today, 70% of rubber involves transportation, 6% footwear, 4% wire and cable).

1898—First planting of Hevea in Malaysia by a Chinese grower named Tan Chan Yoy.

At this time coffee prices slumped and there was interest in establishing a new industry.

1910—Rubber boom; rubber reaches \$3 a pound.

1956—Ridley dies at the age of 101.

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Ecology and Anatomy

Hevea is a tropical evergreen rainforest tree of the Amazon basin, grows in the flooded or drained plateau.

Rubber is planted 15°N to 10°S, temperature of 74–95°F, with well distributed rainfall, 75–100 inches per year.

Tree is fast growing, about 24 m maximum height.

Latex vessels are modified sieve tubes of the phloem, run counterclockwise, 2-1/2° to the vertical.

Thus tapped in clockwise direction



Hevea Rubber Tree



Rubber Production (2001)

Continent	1000 tonnes	Chief countries
World	5636	
Africa	281	Nigeria (105), Ivory Coast (97), Central Africa Republic (50)
North America	20	El Salvador (20)
South America	36	Brazil (30)
Asia	5297	Thailand (1667), Indonesia (1312), Malaysia (1074)
Oceania	3	Papua New Guinea (3)

Propagation

Seed (used for rootstocks; seed tree can be identified by seed marking)

Budding

Cutting; only from young (juvenile trees) using mist propagation. Leafy cuttings can be used but root system is poor and trees blow over easily

Marcottage (air layering)



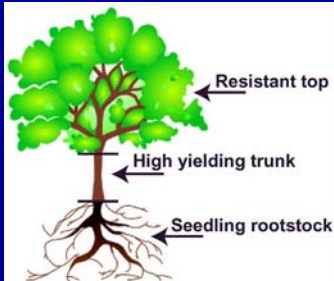
Budding Rubber Tree



Budding Nursery

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In New World where South American leaf blight (*Dothidella ulei*) is a problem a three part tree may be produced with a seedling rootstock, a high yielding trunk, and a leaf blight resistant top.



Planting

Trees are usually planted about 15×15 feet apart.



Rubber estate

Tapping

A jeboug knife is used, a knife with a V-shaped cutting edge which leaves a grooved channel for latex to flow.



Present method is a single spiral $1/2$ diameter of the tree.

Cutting is repeated 1 to 3 days; $1/16''$ per cut, $7/8''$ per month, $10''$ per year.

There are different systems on the length of the spiral and frequency of cut.

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The intensity of tapping is indicated by the formula
 $S/2 d/2 = 100\%$

S/1 is a full spiral
S/2 is a half spiral
d/1 is a daily tap
d/2 is a tap on alternate days.

Trees are usually tapped for 6 months and rested for 3 months.

The herbicide 2,4-D or ethephon is used to stimulate flow.

These prevent sealing of the cut ends.

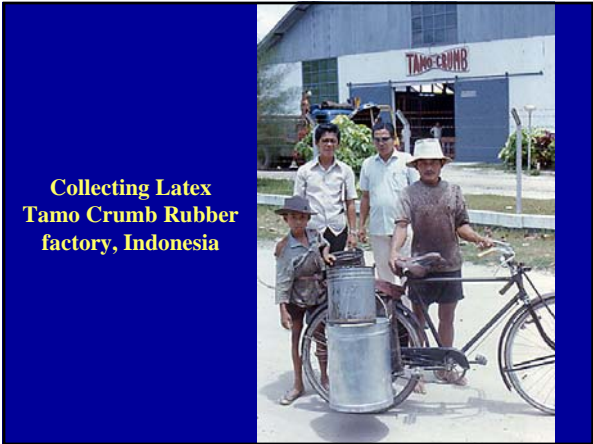




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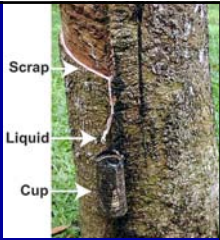




Collecting Latex
Tamo Crumb Rubber
factory, Indonesia

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Processing
There are three types of latex
Liquid—Highest quality
Cup rubber—The cut-lump that sticks to the plastic cup
Scrap rubber—Strip of rubber from the cut surface




Coagulation
10–25% ammonia can be added as an anticoagulant
Latex bulked and strained, rubber content 30–35%
Latex diluted with water, poured into coagulation tanks, with acetic or formic acid (1 part 4% formic acid required for 100 parts 12% latex—more if ammonia is added).

Processing Rubber



Sawing cup rubber **Coagulation tanks**

The “curd” is separated from the serum, and squeezed in rollers to 2-1/2 mm thickness, dried in smoke house, bailed for export.
Crepe rubber is compressed granular rubber from sheet rubber that passes through rollers.
Crumbing is the operation that cuts up crepe and compresses into blocks.



Guayule Rubber

In the US there has been interest for many years in obtaining rubber from guayule encouraged by the strategic need to have a local source of rubber (*Parthenium argentatum*, Asteraceae).

Production areas would be the southwestern arid areas of the United States (particularly Arizona) and Mexico.

However guayule cannot be tapped and yields do not compete with Hevea rubber.

However this industry has recently had some encouragement because a number of people, particularly health workers, who use rubber gloves are allergic to Hevea rubber (due primarily to processing contaminants).

Guayule rubber does not impart this allergic reaction and a niche market for guayule rubber may develop.