WIDENING THE HEVEA GENETIC BASE : A NEW IRRDB EXPEDITION TO THE AMAZON, PERU

Ramli Othman, PhD

drramli53@yahoo.com

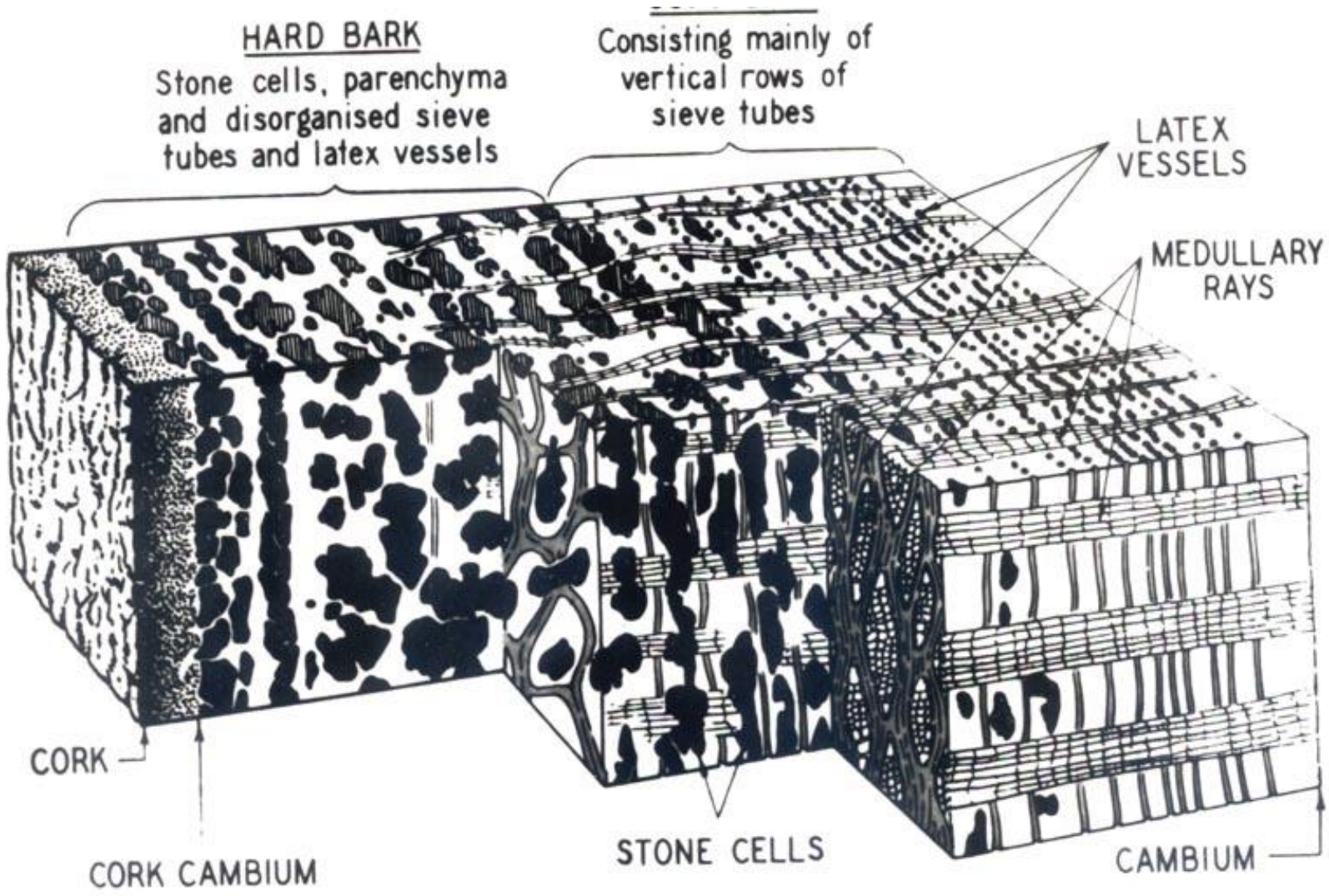
IPCEx 2016 , JOHOR BAHRU, MALAYSIA 02-041116

Natural Rubber

- ***Family* : *Euphorbiaceae***
- ***Genus* : *Hevea***
- ***Species* : *H.brasiliensis, H.pauciflora, H.camargoana, H.nitida, H. spruceana, H.rigidifolia, H.benthamiana, H.guianensis, H.microphylla, H.camporum***


LATEX

BARK


HARD BARK
Stone cells, parenchyma and disorganised sieve tubes and latex vessels
Consisting mainly of vertical rows of sieve tubes
LATEX VESSELS
MEDULLARY RAYS
CORK
CORK CAMBIUM
STONE CELLS
CAMBIUM

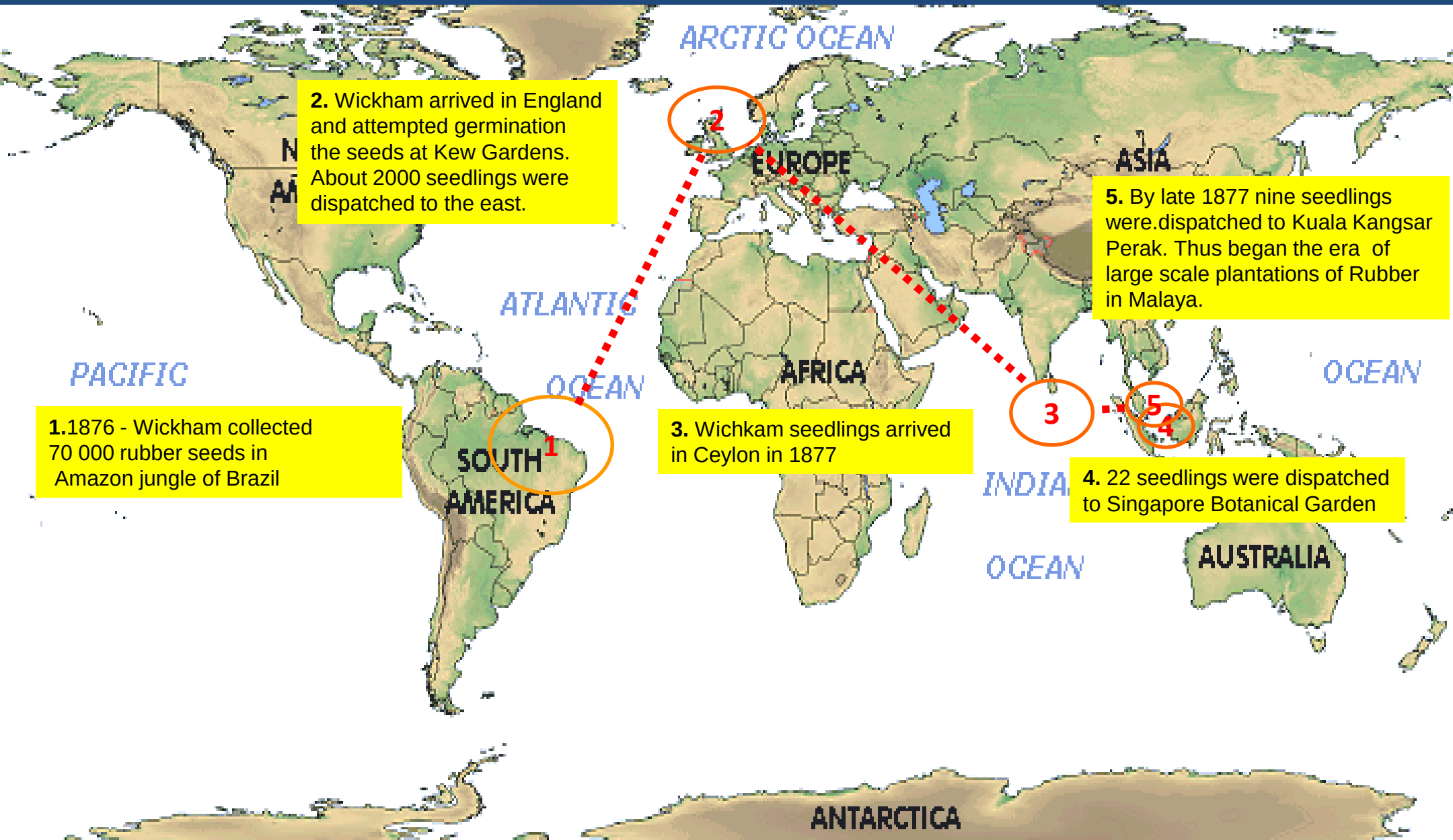
GENUS *HEVEA*

Natural distribution of *Hevea brasiliensis*

Region of origin of genus *Hevea*

- **Grows wild in the Amazon basin in Brazil as the center of diversity**
- **Different species prefer varying habitats**
- **Also growing naturally in the neighbouring countries such as Bolivia, Colombia, Ecuador, French Guiana, Guyana, Peru, Surinam and Venezuela.**

Rubber Introduction to Malaysia



1.1876 - Wickham collected 70 000 rubber seeds in Amazon jungle of Brazil

2. Wickham arrived in England and attempted germination the seeds at Kew Gardens. About 2000 seedlings were dispatched to the east.

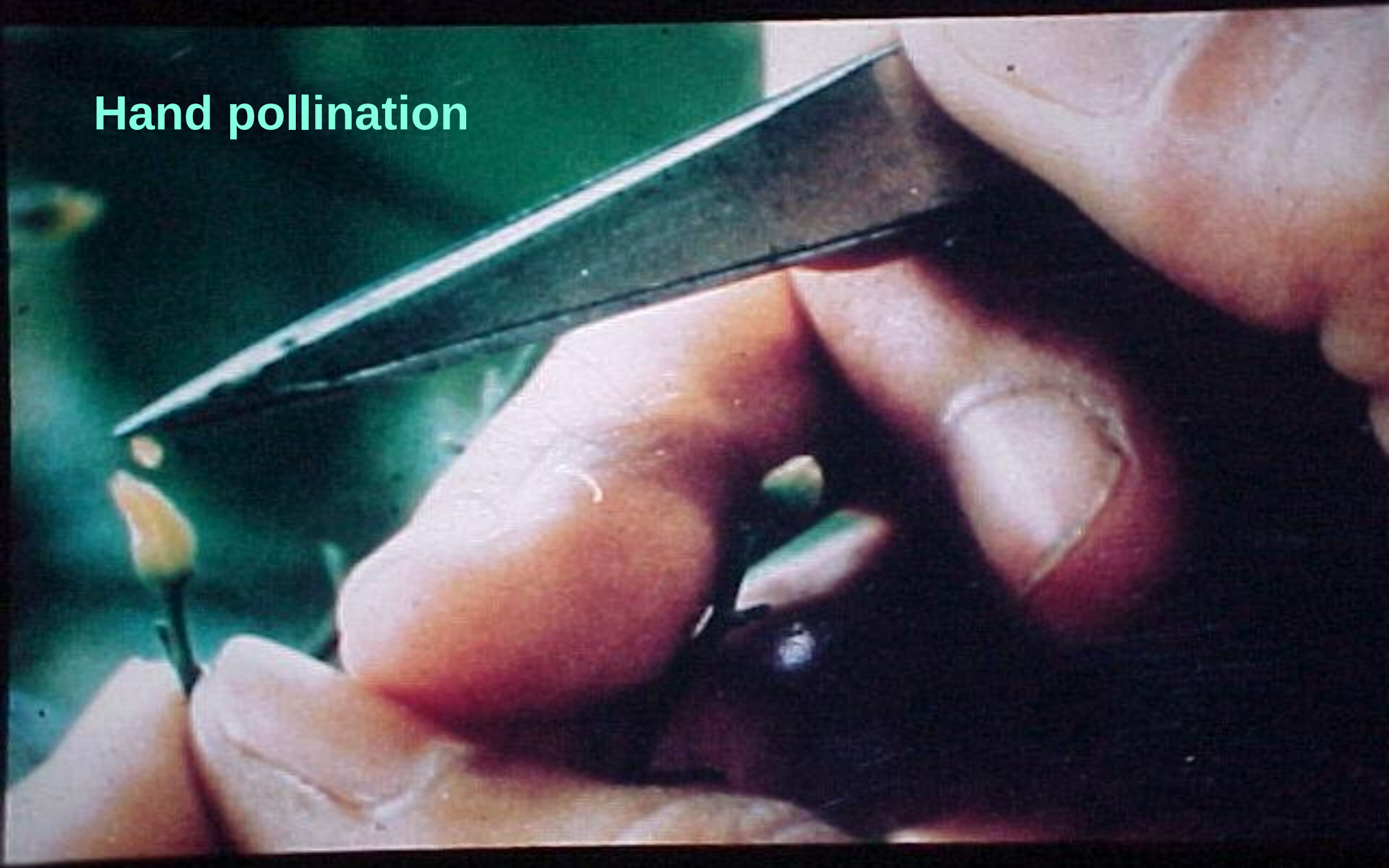
3. Wichkam seedlings arrived in Ceylon in 1877

4. 22 seedlings were dispatched to Singapore Botanical Garden

5. By late 1877 nine seedlings were.dispatched to Kuala Kangsar Perak. Thus began the era of large scale plantations of Rubber in Malaya.


Oldest Rubber Tree - Kuala Kangsar
Planted in 1877

HENRY N. RIDLEY:
"FATHER OF THE MALAYSIAN RUBBER INDUSTRY"


Hand pollination

HEVEA BREEDING PROGRAMME

Planting Recommendation

Updating the list of clones recommended for planting

LSCT

- *Replicated trials in different environments*
- *Selection of Group I clones*

SSCT

- *Replicated plots*
- *Selection of potential clones*

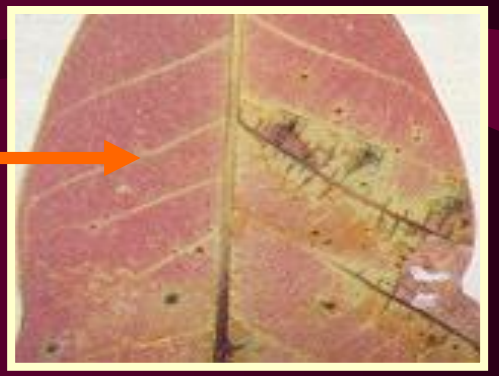
HPST

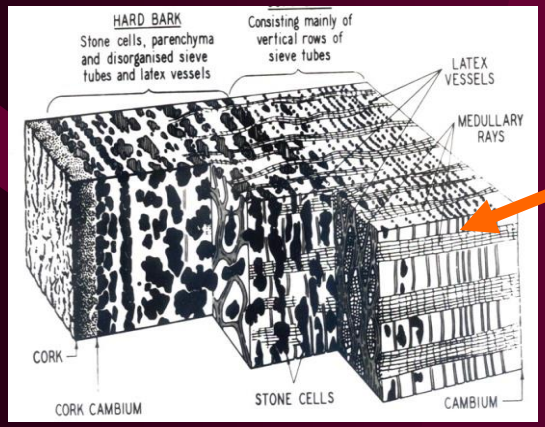
- *Early evaluation*
- *Selection of promising progenies*

Hand Pollination

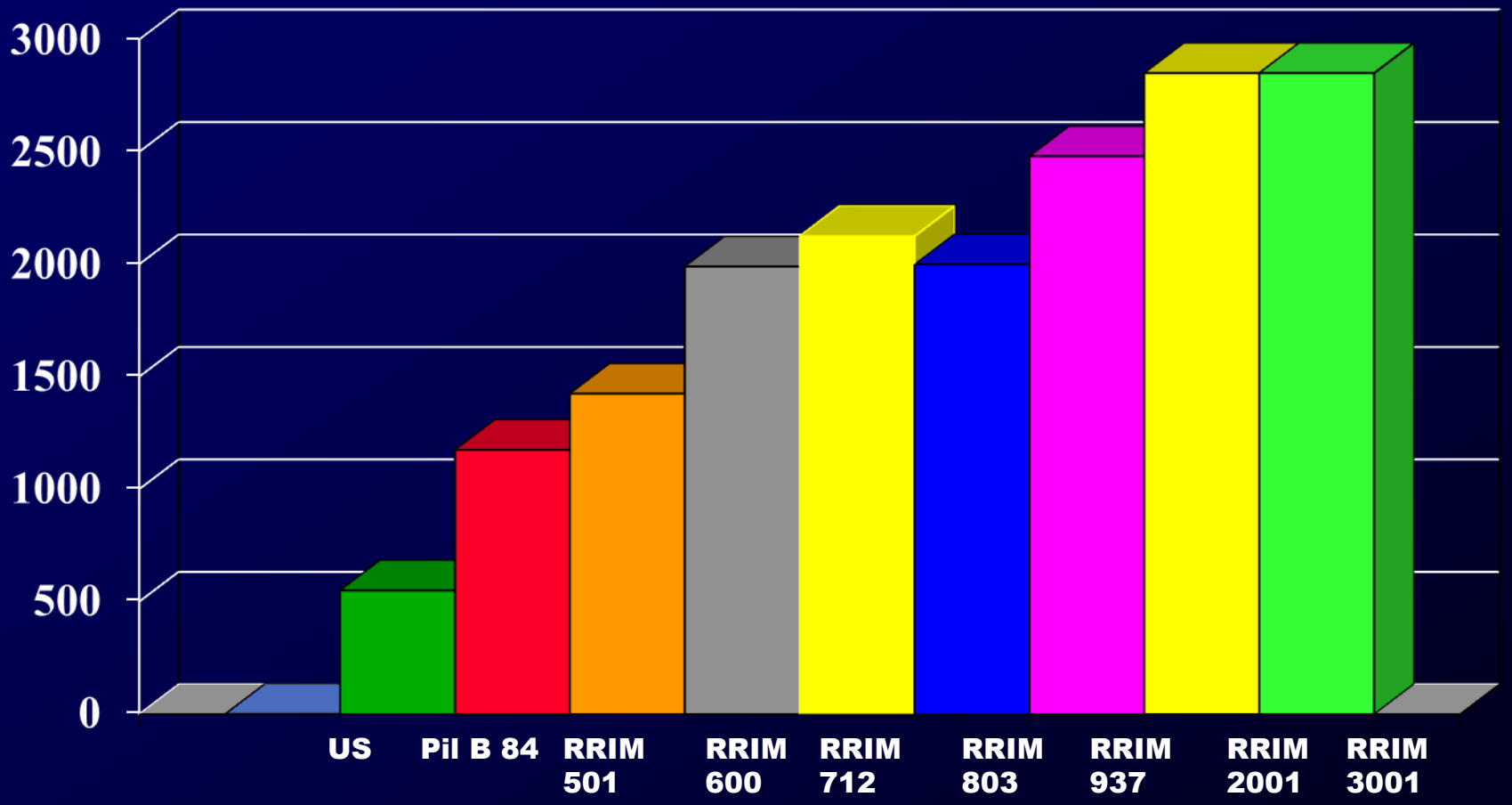
- *Crossing between high yielding clones*
- *Incorporating new germplasm in the crosses*

Challenges in Breeding





Increase In Latex Yield Through Breeding



The increase in latex yield from 550 kg/ha/yr by the unselected seedling to 2850 kg/hayr by RRIM 2001 indicated the tremendous success of the RRIM rubber breeding programme

RUBBER INDUSTRY 2015

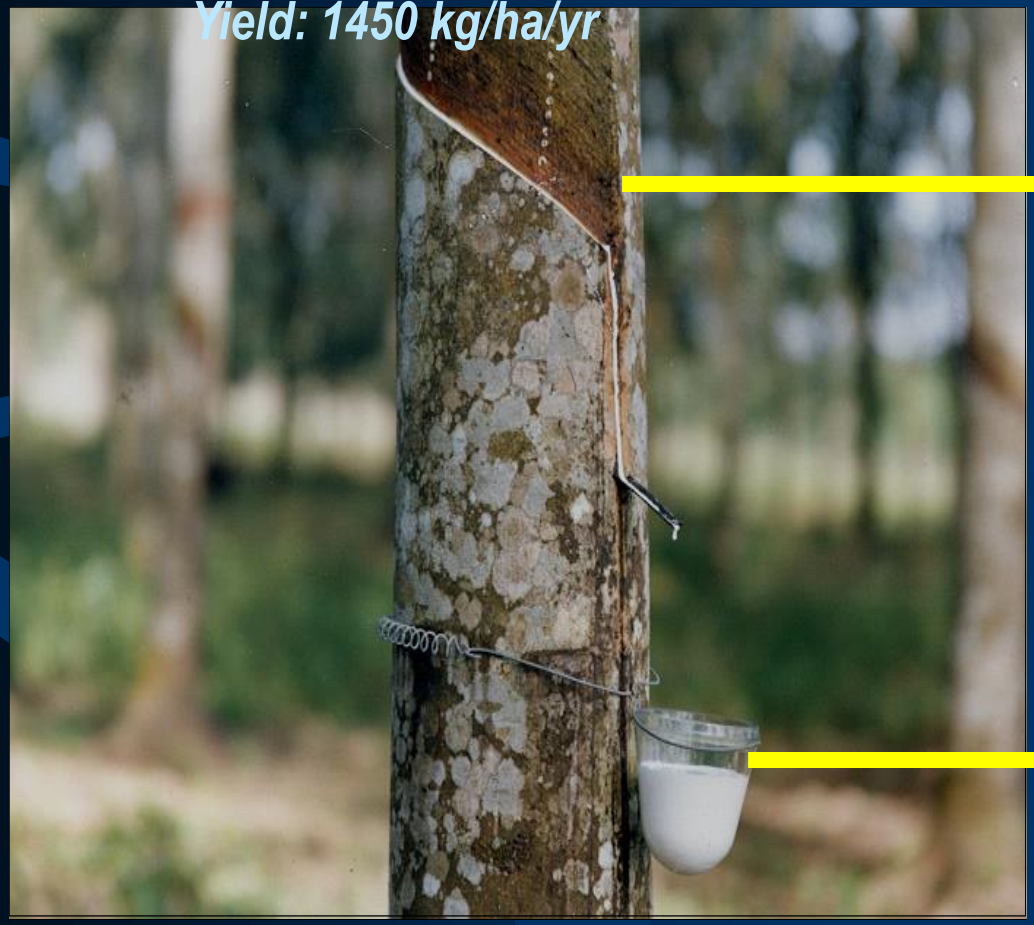
Export: RM 33.30 b (US 8.40 b)

UPSTREAM

Area: 1.07 m ha

Production: 0.72 MT

Yield: 1450 kg/ha/yr



DOWN STREAM

RM 8.13 b (US 2.03 b)

RM 17.99 b (US 4.50 b)

Narrowness of *Hevea* Genetic Base

- A major obstacle towards improving the rubber yield and other important character
- Widely discussed by plant breeders at various forums both national and international

IRRDB 1981 EXPEDITION

AREAS OF COLLECTION - 1981

Boim

Acre

Rondonia

Mato Grosso

Collections

- 64,736 seeds
- 1,522 budsticks from 194 mother trees

Malaysia

- 24,030 seeds
- 15,137 germinated
- 14,316 seedlings quarantine for 3 months
- 13,089 planted IRRDB 1981 Germplasm

(Acre, Rondonia, Mato Grosso)

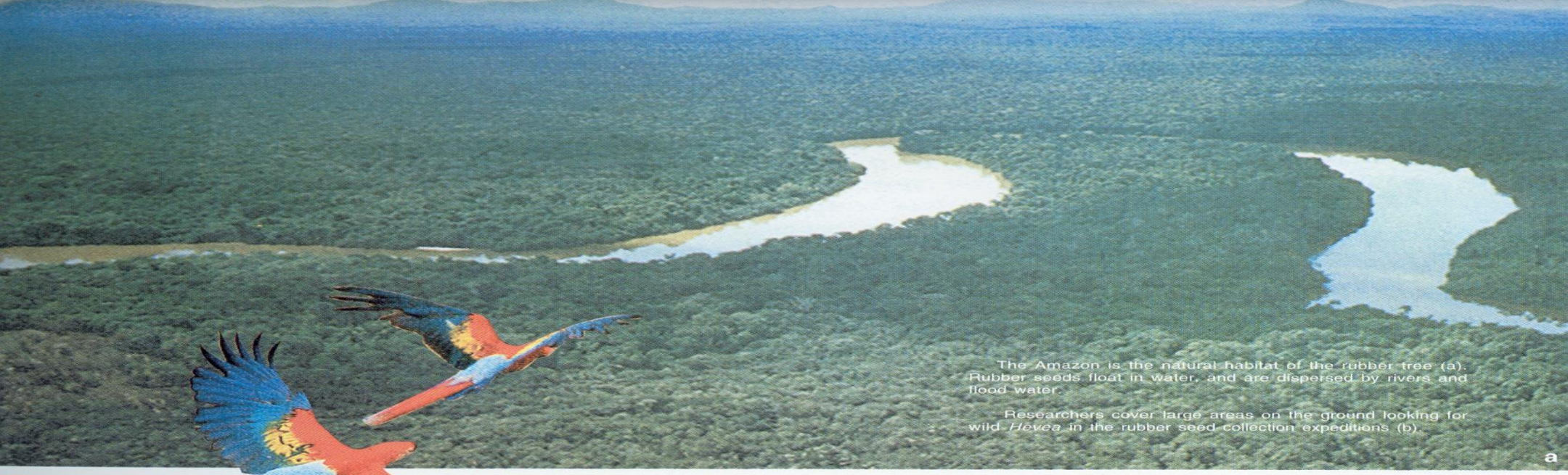
Germplasm 1981

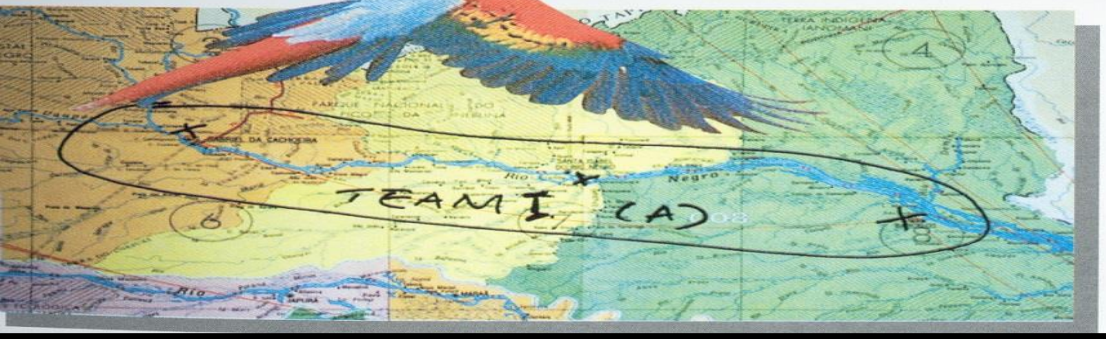
Conservation of IRRDB 1981 Germplasm

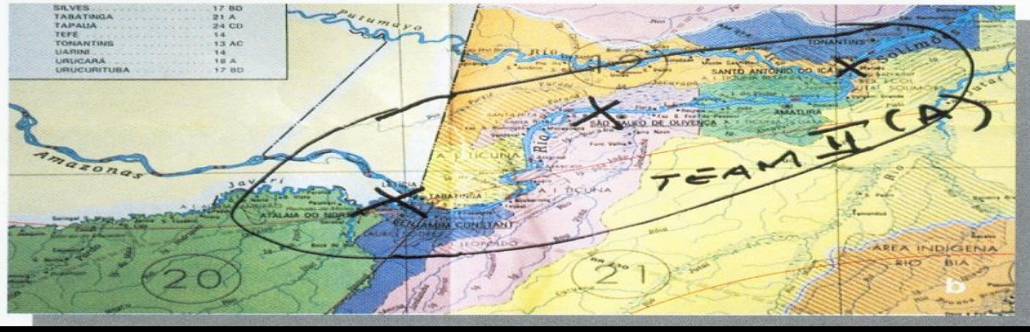
Institute/Country	No. of Genotypes	
	Malaysia	Ivory Coast
1. Rubber Research Institute of Malaysia (RRIM)	13098	-
2. Rubber Research Institute of Vietnam (RRIV)	3672	80
3. Rubber Research Institute of Thailand (RRIT)	3120	-
4. Rubber Research Institute of India (RRII)	4548	-
5. Indonesian Rubber Research Institute (IRRI)	8749	-
6. Chinese Academy of Tropical Agriculture (CATAS)	8000	-
7. CIRAD Côte d'Ivoire	380	2467
8. CIRAD French Guyana	24	300

Utilization

- **Direct Use**
  -- *timber production / rubber forest*
- **Hybridization**
  -- *G xW, W x G, BX*
- **Widening the Genetic Base**







RRIM 1995 EXPEDITION TO THE AMAZON

AREAS OF COLLECTION - 1995

Tabatinga

- Rio Solimoes

Benjamin Constant

- Rio Solimoes, Feijoal, Capacete, Guanabara

Atalaia do Norte

- Rio Javari, Rio Itaquai, Santa Cruz, Paumari, Contra Banco

Sao Paolo do Olivencia

- Rio Solimoes, Camatian, Santo Rita do Weil, Santa Clara, Santa Rose, Parana Parao, Campo Alegre, Boa Esperansa, Porto Novo

Objective

- To collect seeds of various *Hevea* species from the Amazonas of Brazil with the purpose of increasing the *Hevea* genetic pool in Malaysia


20
SPEED

RRIM 1995 Expedition

Collections ---Malaysia

- 436,845 seeds (*H. brasiliensis*, *H. guianensis*, *H.spruceana*, *H,rigidifolia*, *H.pauciflora*, *H.benthamiana*, *H. nitida* and Interspecific hybrids)
- 72,833 germinated (16.6 %)
- 50,357 planted JPSM Rantau Panjang, Batu Arang, Selangor

Various *Hevea* spp

H. pauciflora

H. spruceana

H. camargoana

H. rigidifolia

H. nitida

H. benthamiana

H. brasiliensis

H. guianensis

H. microphylla

H. camporum

The 1995 *Hevea* Germplasm

The 1995 *Hevea* Germplasm

H. brasiliensis

The 1995 *Hevea* Germplasm

H. benthamiana

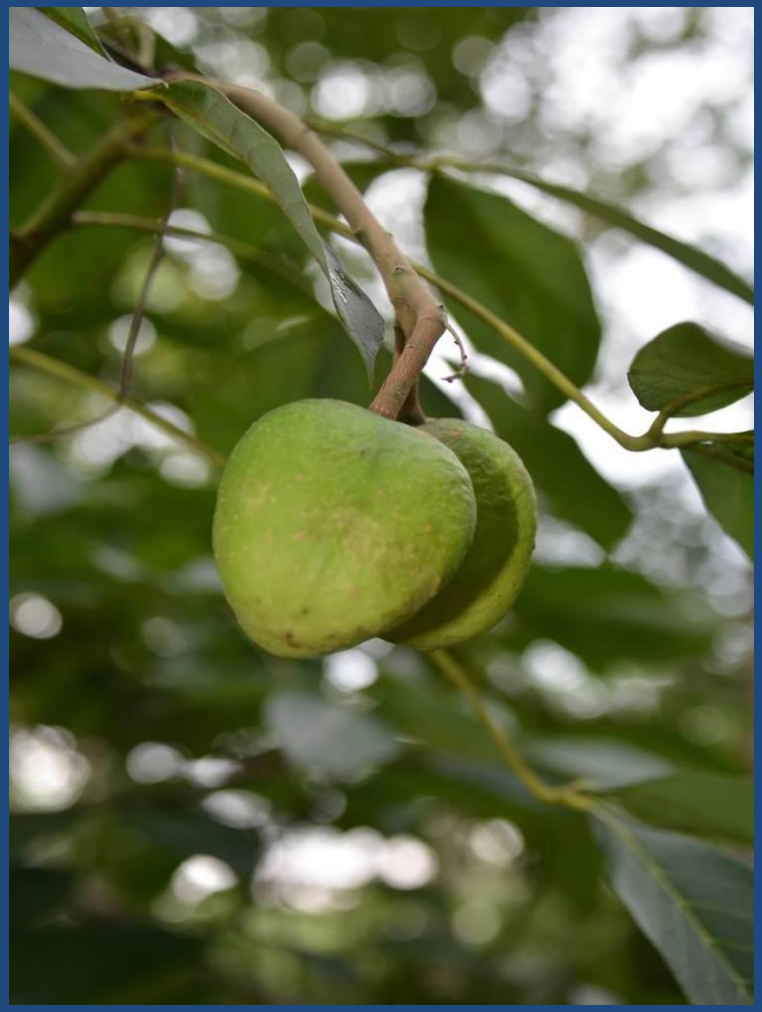
H. pauciflora

The 1995 *Hevea* Germplasm

H. nitida

H. spruceana

The 1995 *Hevea* Germplasm



Fruit of H. spruceana

The 1995 *Hevea* Germplasm

H. guainensis & fruit

The 1995 *Hevea* Germplasm

The 1995 *Hevea* Germplasm


IRRDB 2017 EXPEDITION: PERU


CLICK HERE FOR LARGER MAP
©GraphicMaps.com
EQUATOR
Quito
Ecuador
Colombia
Napo River
Putumayo River
Amazon River
Tumbes
Maranon River
Iquitos
Brazil
Yunmaguas
Piura
250 mi
250 km
Andes Mts.
Ucayali River
Chiclayo
AMAZON JUNGLE
Trujillo
Pucallpa
Chimbote
Madre de Dios River
Huaraz
Apurimac River
Peru
Huancayo
Machu Picchu
Manu N.P.
Pacific Ocean
Lima
Ayacucho
Cuzco
Bolivia
Pisco
Ica
Andes Mts.
Nazca
Lake Titicaca
Arequipa
La Paz
Matarani
Ilo
Chile
Tacna
PERU
LOW / HILLS / MOUNTAINS
WorldAtlas.Com
NORTH AMERICA
Atlantic Ocean
Caribbean Sea
Pacific Ocean
PRIME MERIDIAN
AFRICA
©GraphicMaps.com
0°
EQUATOR
N
W
E
S
0°
SOUTH AMERICA
Peru
1000 mi
1000 km
23°5'S
TROPIC OF CAPRICORN
0°
23°5'S
Pacific Ocean
Atlantic Ocean
90°W

AREAS OF COLLECTION
1876, 1981& 1995

Boim/Wickham

Amazonas

Acre

Rondonia

Mato Grosso

Objective

To collect seeds of various *Hevea* species from the Amazon of PERU with the purpose of increasing the *Hevea* genetic pool in the IRRDB member countries…Towards Enhancing *Hevea* Genetic Improvement

Justification for Expedition

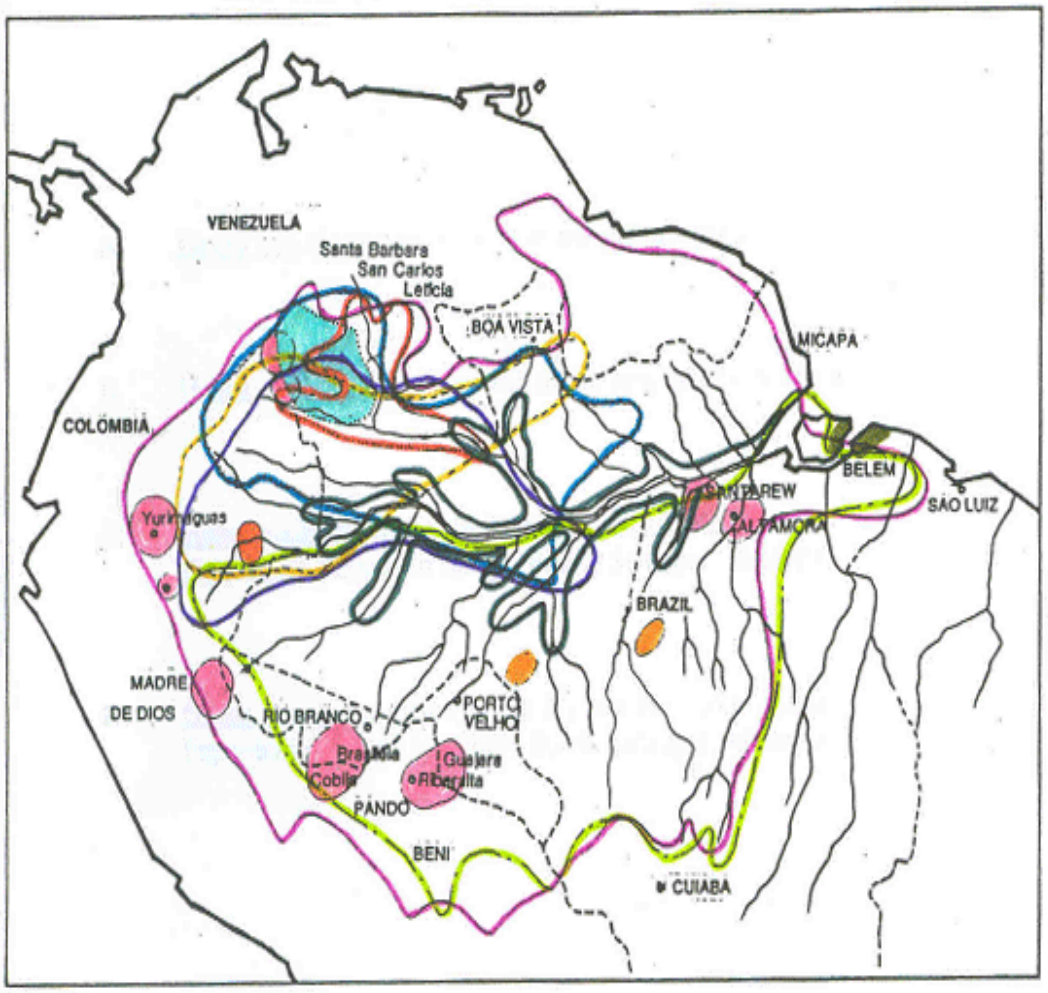
- **Continuing and widespread destruction of the wild genetic resources due to conversion of the native habitat to agriculture in a number of countries in South America.**

- **Further progress in Hevea breeding for better yields for both latex and timber can be achieved through the widening of the narrow genetic base of the crop.**

- **There is evidence that genes for disease resistance and other desirable traits such as tolerance to low temperature maybe found in the *Hevea* species in Peru.**

- **Advances in biotechnological research has opened up opportunities for plant breeders to shorten the time to produce cultivars with desirable traits.**

MAP 1
MAP OF SOUTH AMERICA SHOWING THE CENTRE OF DIVERSITY FOR HEVEA



Species Distribution

- ***H.brasiliensis*** **– South of Amazon river (Brazil, Bolivia, Ecuador& Peru) and some parts of northern region of the Amazon River, west of Manaus and small area south of Colombia.**
- ***H. guianensis*** **– throughout the geographical range of the genus (Brazil, Venezuela, Bolivia, French Guiana, Peru, Colombia, Surinam & Ecuador)**
- ***H. pauciflora*** **– north and north west of Amazon river (Brazil, Guianas & Peru)**
- ***H. nitida*** **– between rivers of Uaupes & Icana, tributaries of the upper Negro river (Brazil, Peru & Colombia)**
- ***H. rigidifolia*** **– among Negro river and its affluents,Vaupes and Icana rivers (Brazil, Colombia & Venezuela)**
- ***H. spruceana*** **– banks or the Amazon river, start at confluence with Rio Putumayo (borders of Colombia & Peru) and extend eastward to sea coast**
- ***H. camargoana*** **– restricted to Marajo island of the Amazon river delta (Brazil)**
- ***H. camporum*** **– south of Amazon between Marmeloes and Manicore rivers, tributaries of Madeira river (Brazil)**
- ***H. microphylla*** **– middle and upper reaches of Rio Negro (Venezuela)**

The Great Amazon River

Hevea Species

H. pauciflora

H. spruceana

H. camargoana

H. rigidifolia

H. nitida

H. benthamiana

H. brasiliensis

H. guianensis

H. microphylla

H. camporum

AMAZON PERU

- From east of Andes to borders with Colombia, Ecuador, Brazil & Bolivia
- Comprise 60 % of Peru
- Second largest portion of the Amazonian rainforest after Brazil rainforest (16.13 % of whole rainforest)
- Dense jungle with large degree of Biodiversity

Amazon Peru – 2 eco regions

1. **Lowland Jungle Amazonian Rainforest**
   - **Altitude 80 – 1000 m asl**
   - **Temperature av. 28^{o}C**
   - **High relative humidity (>70 %)**
   - **Rainfall 260 cm /year**

Amazon Peru – 2 eco regions

2. **Highland Jungle**

   -Eastern foothills of Andes

   - Altitude 1000 – 3800 m. asl

   - Temperature are warm in lowlands and cooler in higher altitudes.

Rivers in Amazonian Peru

- Apurimac
- Montaro
- Amazon
- Urubamba
- Ucayali
- Huallaga
- Maranon
- Putumayo
- Yavari
- Napo
- Madre de Dios
- Pastaza
- Manu
- Purus
- Tigre

The Great Amazon River

Primary Cities in Amazonian Peru

- Iquitos (500,000 p)
- Pucallpa (380,000 p)
- Yurimaguas (140,000 p)
- Puerto Maldonado (104,000 p)
- Tarapato (181,000 p)
- Jaen (86,000 p)
- Moyobamba (77,000 p)
- Bagua (65,000 p)
- Rioja (60,000 p)

Areas of Prospection in Peru

- The quadrangle bounded by Iquitos, Lecitia and Rio Putumayo
- Madre de Dios around Puerto Maldonado
- San Guan de Oro near the border of Bolivia
- North of Pucallpa along Rio Ucayali
- Tocache Nuevo are which is situated on the North-West of Tingo Maria
- San Ramon and Puerto Bermudez which is South of Tingo Maria
- The area west of Rio Yurimaguas


Amazon Rainforest Peru


Amazon Rainforest Peru


Amazon Rainforest Peru

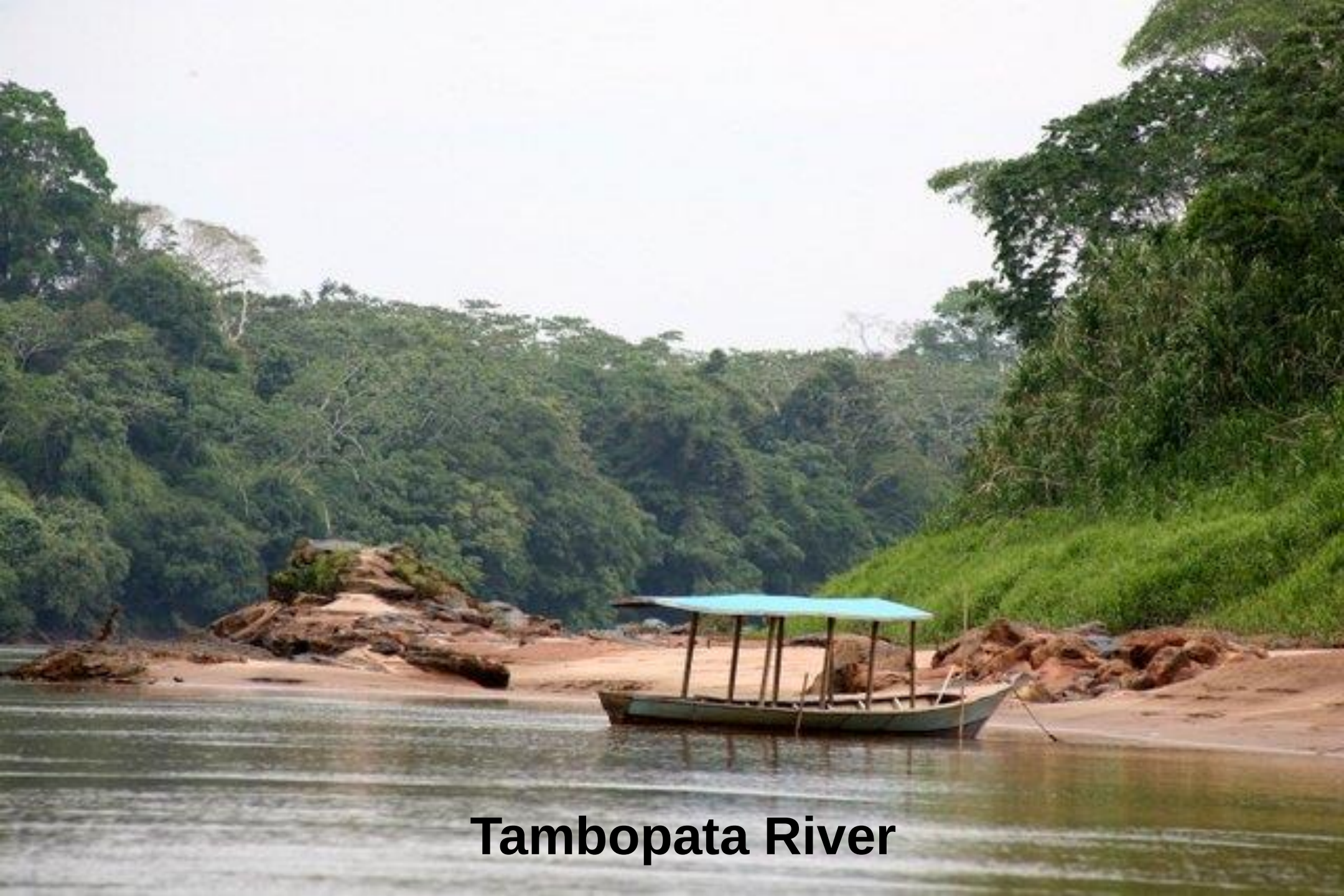

Amazon Peru


Putumayo River


Madre de Dios River


Huallaga River

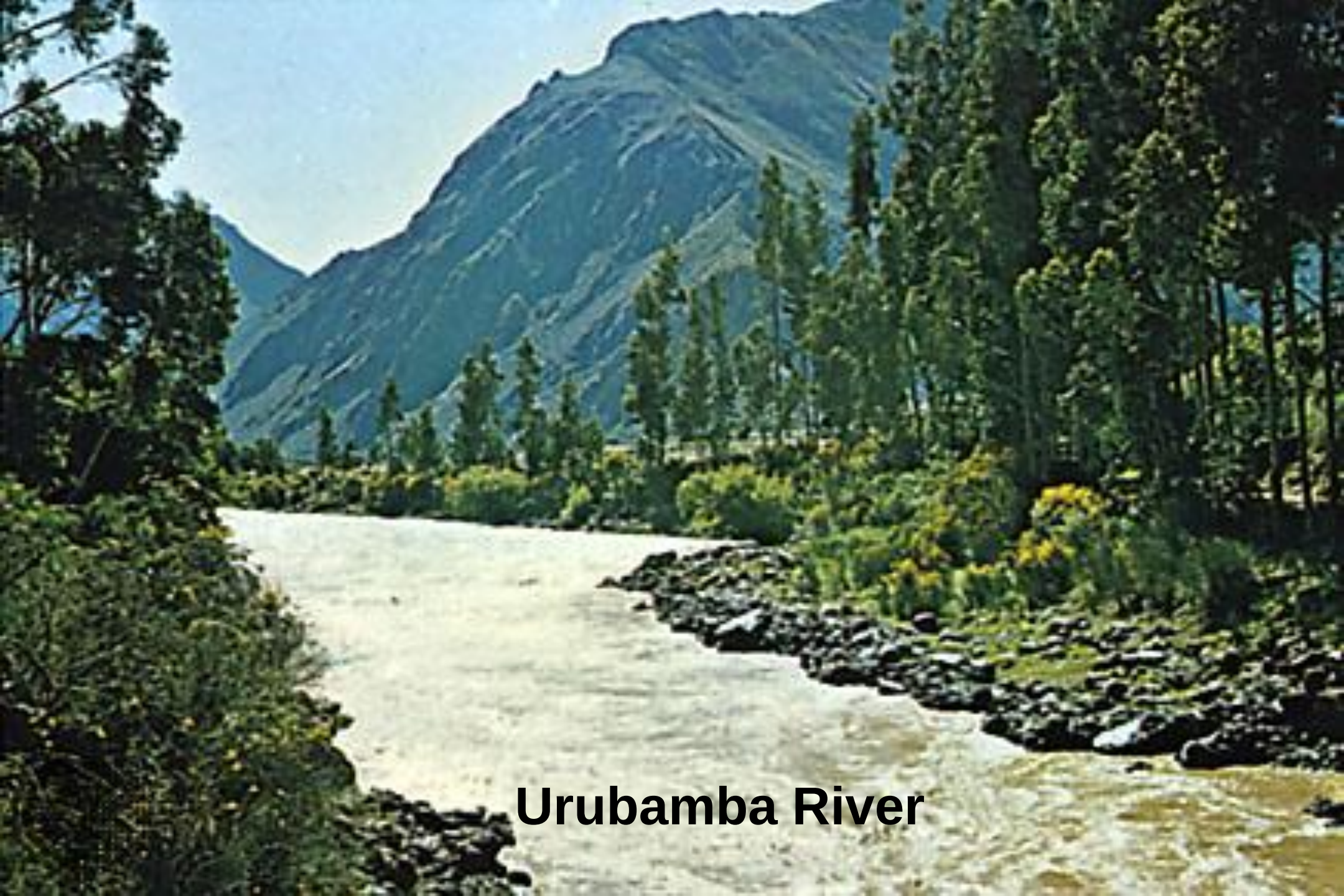
Mayo River



Tambopata River


Amazon Rainforest Peru


PERU…. WE ARE COMING


Urubamba River

Andes Mountain

Wild Life in Amazon

Wild Life in Amazon


ON BONGO


© AP


Tumbes
Iquitos
Talara
Piura
Chiclayo
Tarapoto
Cajamarca
Trujillo
Pucallpa
Anta (Huaraz)
Huánuco
Puerto
Maldonado
Lima
Huancayo
Ayacucho
Cusco
Andahuaylas
Juliaca
Arequipa
Major Airports
in Peru
Tacna


G-COVA

Utilization

- **Direct Use**
- **Hybridization**
  -- *G xW, W x G, BX*
- **Widening the Genetic Base**


Muchas Gracias
Muito Obrigado
Terima kasih
Thankyou