# Presentation to
# INTERNATIONAL LOW-CARBON ENERGY TECHNOLOGY PLATFORM
## on the use of rapidly growing bamboo and its processing for biomass energy generation and use in socio-economic development



**Project Owner**

**Green Grid Energy (Pty) Ltd**

**DEREK NAIDOO**

**Technical Partner**

**Dr. N.Barathi, Director**

**Growmore Biotech Ltd.**

**Erode, TN**


**GROWMORE BIOTECH - TECHNOLOGY PARTNER OF NMBA**

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# GREEN GRID ENERGY BEEMA BAMBOO TO ENERGY PROJECT

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# BEEMA BAMBOO TO ENERGY

- The project scope entails the cultivation of 500 hectares of beema bamboo, in the Ilembe District, the setup of a laboratory and nursery at the Dube Trade Port and a power plant (3.6MWe) in Isithebe. The project kick of date is November 2013, with planting of the bamboo shoots starting in Decembe2013/ January 2014.

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# BEEMA BAMBOO TO ENERGY – PLANTATION SITE


Renewable Energy
& Carbon Sink
by BambOO

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# Bamboo to Energy National Demonstration Project

# BAMBOO : National demonstration project

- Plantation: 500 hectares
- Power Plant: 3.6MW gasifier
- Nursery: 2,5 million plants per year
- Carbon sequestration: 200tCO2/ha/a
- Job creation: 370 full time jobs
- Localization – skills and technology development and transfer
- Eskom co-firing
- Mining and Wasteland rehab
- Pulp and paper industry strategic partnership

# BEEMA BAMBOO TO ENERGY

- This initiative in South Africa is a national demonstration project that will enhance the use of the beema bamboo biomass feedstock for the generation of electricity. The growing of bamboo will assist Eskom in acquiring much needed sustainable biomass feedstock for the co-firing of their power stations.

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# BEEMA BAMBOO TO ENERGY

- Eskom has to reduce its reliance on fossil fuels by 10%, and replace it with a sustainable biomass feedstock by 2026. This translates to 12 million tons of biomass feedstock per annum, hence the strategic nature of the project, to this extent Green Grid has signed a Non -Disclosure Agreement with Eskom with regards the research and development of the project.

# BEEMA BAMBOO TO ENERGY

- The District Council of Ilembe pledged its support for the project and has the facilitated 500 hectares of land in the Local Municipality of Mandeni for this project

- The District Council has in addition, committed to providing assistance in ensuring that all the legal requirements are met for the establishment of the project.

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# BEEMA BAMBOO TO ENERGY

- South Africa needs a Sustainable Biomass Feed stock for energy generation.
- To provide a product that can create a sustainable supply of BIOMASS FEEDSTOCK by establishing, a tissue culture laboratory for the propagation of the bamboo shoots, a bamboo energy plantation and a power plant that will use the bamboo as a feedstock to generate electricity.

# BEEMA BAMBOO TO ENERGY

- “Beema” is a specially bred variety by Dr. N. Barathi of Growmore Biotech Ltd., which has a potential to grow very fast and yields very high biomass due to the fact that the wall thickness of “Beema” Bamboo is 3 times more than other bamboo.
- The carbon content of “Beema” Bamboo is between 46 to 48%.

# BEEMA BAMBOO TO ENERGY

- The dry matter production of “Beema” Bamboo under optimum condition reaches 40 to 50 tons per acre or 100 to 125 tons per hectare.

- The total carbon accumulation every year, after 5 years of growth is from 18 tons to 23 tons per acre, which is equivalent to 69 tons to 80 tons per hectare respectively.

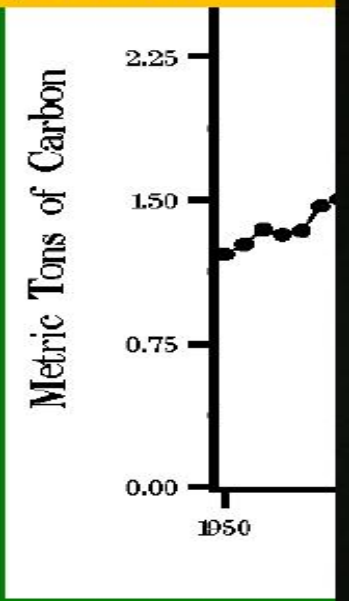
# BEEMA BAMBOO TO ENERGY

- Due to this fact, “Beema” Bamboo acts as a “Carbon Sink”. When “Beema” Bamboo is grown individually in the gardens and parks, it sequesters 400 to 500 kg. Of carbon di-oxide every year, thereby reduces the Carbon di-oxide in the surrounding places.
- “Beema” Bamboo generates 70 to 80 CER per acre / year, which is equivalent to 175 to 200 CER per hectare every year.

# BEEMA BAMBOO: CARBON SINK

## Per capita Carbon Emission Estimates for SA

**Per capita $CO_2$ Emission 8.5 TONS co2 / person**




# BEEMA BAMBOO: CARBON SINK

# BEEMA BAMBOO: CARBON SINK

Bamboo minimizes $CO_2$ gases and generates up to 3-4 times more oxygen than equivalent stand of trees.

Bamboo sequesters 62 tons of $CO_2$/year in 1 hectare

(source: J.Janssen, Technical University Eindhoven, 2000)

1 hectare of young forest sequesters 30 to 40 tons of $CO_2$/year

**NEW "Beema" Bamboo sequesters 200 tons of $CO_2$/year in 1 hectare**

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## Brief Presentation on :

1. Bamboo as fuel
2. Bamboo as “Energy Plantation”
3. Bamboo Biotech
4. Best Practices in Bamboo Energy Plantation

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# 1. Bamboo as fuel

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# Calorific value of bamboo is 4000 kcal/kg

# Ash < 1%

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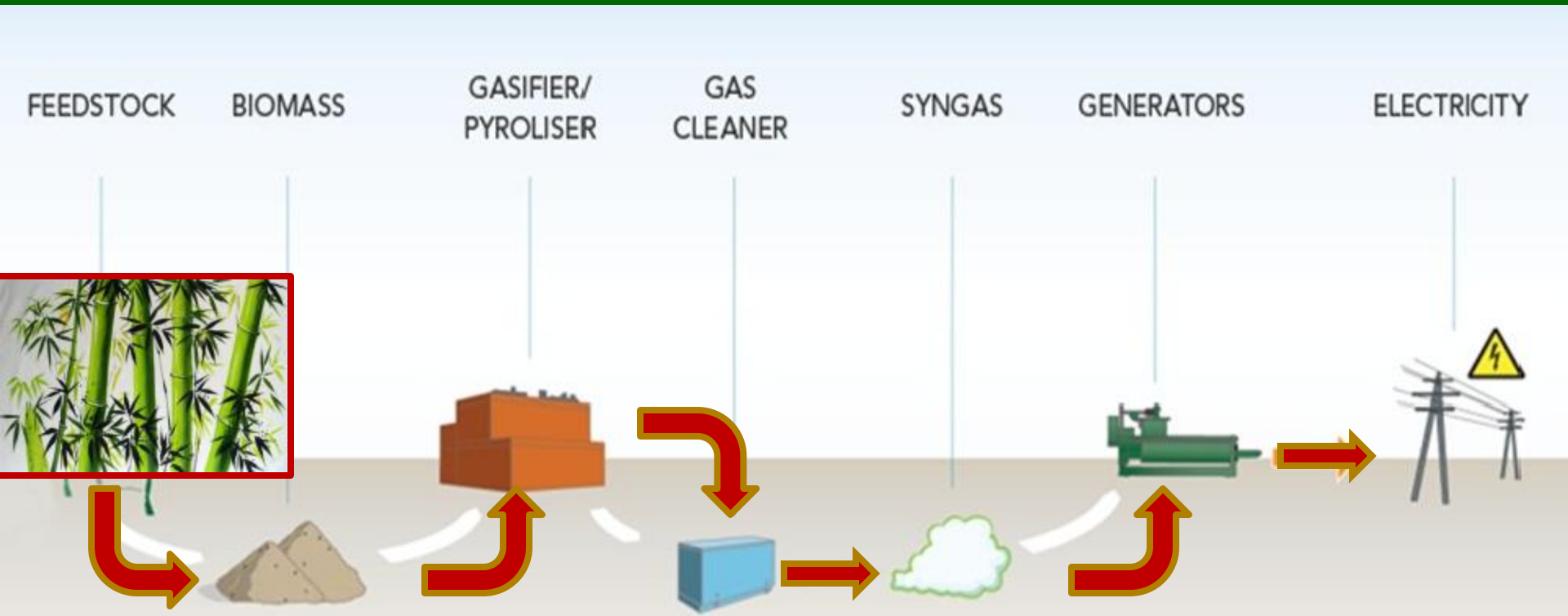
# Plantation to Green Energy

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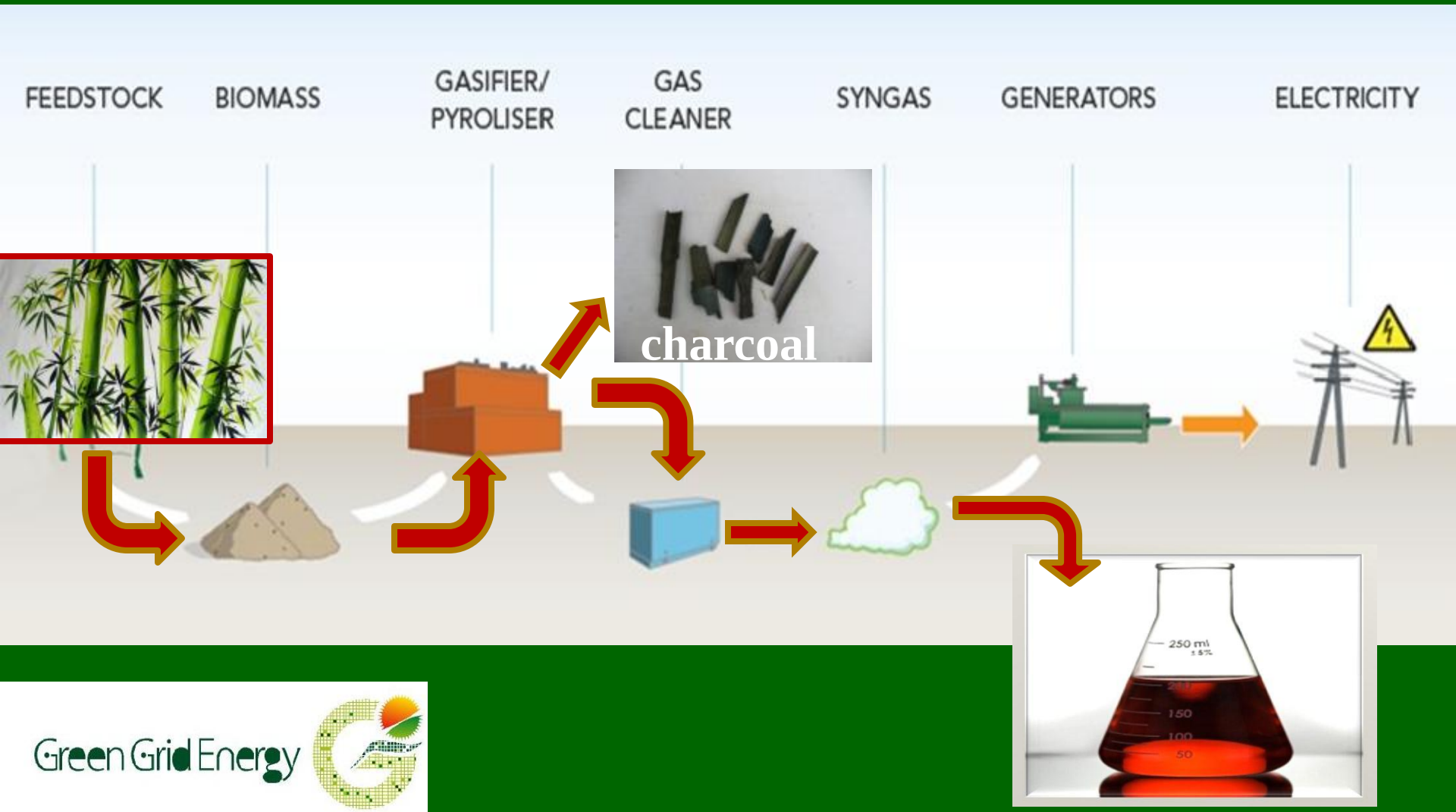
# Plantation to Green Energy

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# Fuel Characters of Bamboo

| PARTICULARS | | VALUE |
|---|---|---|
| Total Moisture | : | 12to 15% |
| Ash content | : | 0.4 to 1.0 % |
| Volatile Matter | : | 80 to 83% |
| Fixed carbon | : | 5 to 6 % |
| Total sulphur | : | 0.05 to 0.06% |
| Carbon | : | 48 to 52% |
| Gross Calorific value | : | 3600 Kcal/Kg |
| Nett Calorific value | : | 4050 Kcal/kg |
| Bulk Density | : | 0.4 ton/$m^3$ |

| Elemental Ash Analysis (% of dry matter) of Bamboo | | |
|---|---|---|
| SiO2 | : | 0.045% |
| Al203 | : | 0.004% |
| Fe203 | : | 0.02% |
| TiO2 | : | 0.000% |
| CaO | : | 0.15% |
| MgO | : | 0.021% |
| Na2O | : | 0.003% |
| K2O | : | 0.415% |
| P205 | : | 0.130% |
| SO3 | : | 0.028% |
| | | |
| Ash deformation Temperature | : | 1300 to 1350 degree C |
| Ash Fusion Temperature | : | 1400 to 1450 degree C |

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# ADVANTAGE OF BEEMA BAMBOO AS FUEL

- Low ash of 1%
- Continues Harvest every year
- Plant once in 100 years
- Low tar in the bamboo biomass
- In case of exit from Power project, Bamboo has many other alterative uses
- Cost of cultivation is Rs 1000 /Ton

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# HOW BAMBOO

## Become a Hi-Biomass Crop

- Biotechnology played an important role in crop development & improvement of bamboo variety ( < 1 tons/Ac to 10 tons/Ac)
- High biomass yielding bamboo clones developed according to the soil and climate
- Precision farming methods developed for maximizing the biomass yield ( < 10 tons/Ac to 50 tons/Ac)

# Why Bamboo ?

| Particulars | Bamboo | other trees |
|---|---|---|
| ❑ Harvest Rotation | • Every year | • Once in 5 years |
| ❑ Yield | • 100 tons/Ha/yr | • 25 tons/Ha/yr |
| ❑ Cost of production | • Once in over 100 yrs | • Once in 5 to 10 yrs |
| ❑ Replanting | | |

# 2. Bamboo as "Energy Plantation"

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0.5 Ton/Ac

4 - 6 To

40 Ton/Ac

# Burning of bamboo for electricity

**1MW power plant needs 80 Hectare(200 Acer)of Bamboo**

**40 tons X 200 Acer = 8000 Tons of Biomass**

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# 2 years old Beema bamboo


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# Advantages of DEDICATED Energy Plantation

- Long-term fuel contracts
- Low price
- One kind of biomass
- Assured supply
- Adequate supply
- Centralized availability

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# 3. Best Practices in Bamboo Energy Plantation

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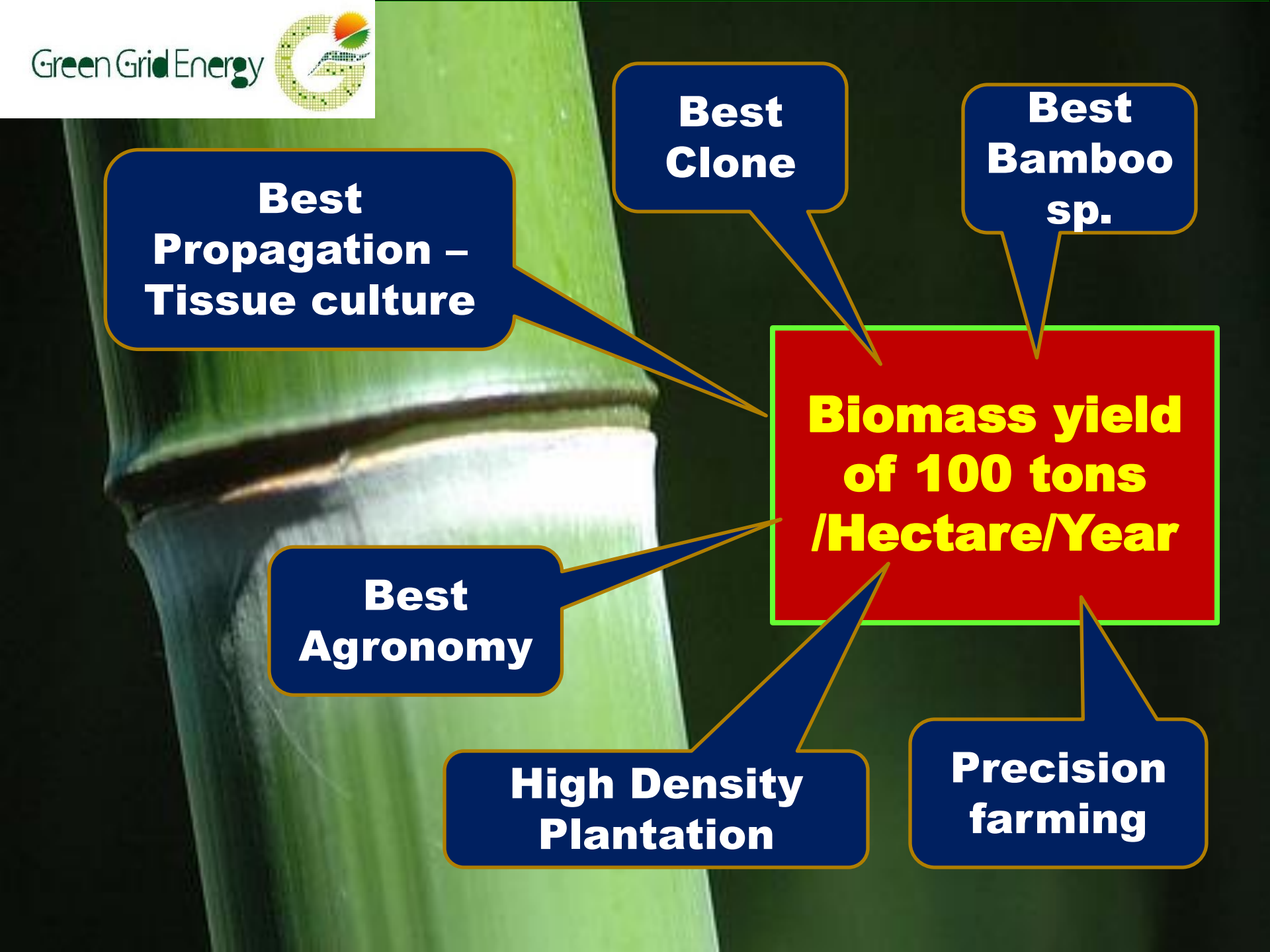
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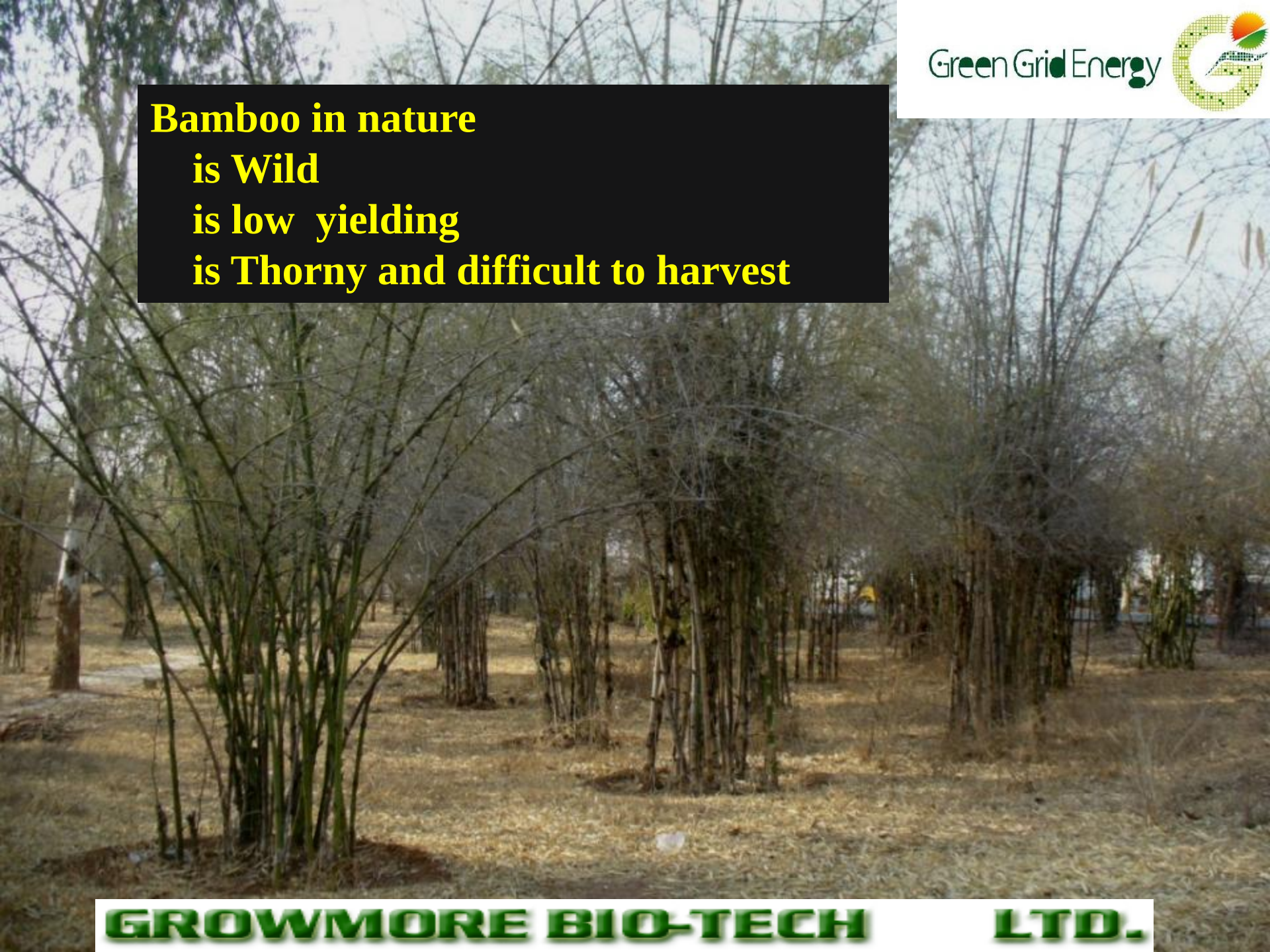
Best Clone
Best Bamboo sp.
Best Propagation – Tissue culture
Biomass yield of 100 tons /Hectare/Year
Best Agronomy
High Density Plantation
Precision farming


There are several 100 species of bamboo in world


Bamboo in nature
is Wild
is low yielding
is Thorny and difficult to harvest
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GROWMORE BIO-TECH LTD.

**Beema Bamboo is CULTIVABLE**
**Beema Bamboo yields over 20 times higher yield than in WILD**
**Beema Bamboo is harvested EVERY year**
**Beema Bamboo is THORN less and EASY to harvest**
**Beema Bamboo is Sterile and does not die for over centuries**

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**BAMBOO PLANTATION - 2 YEARS**

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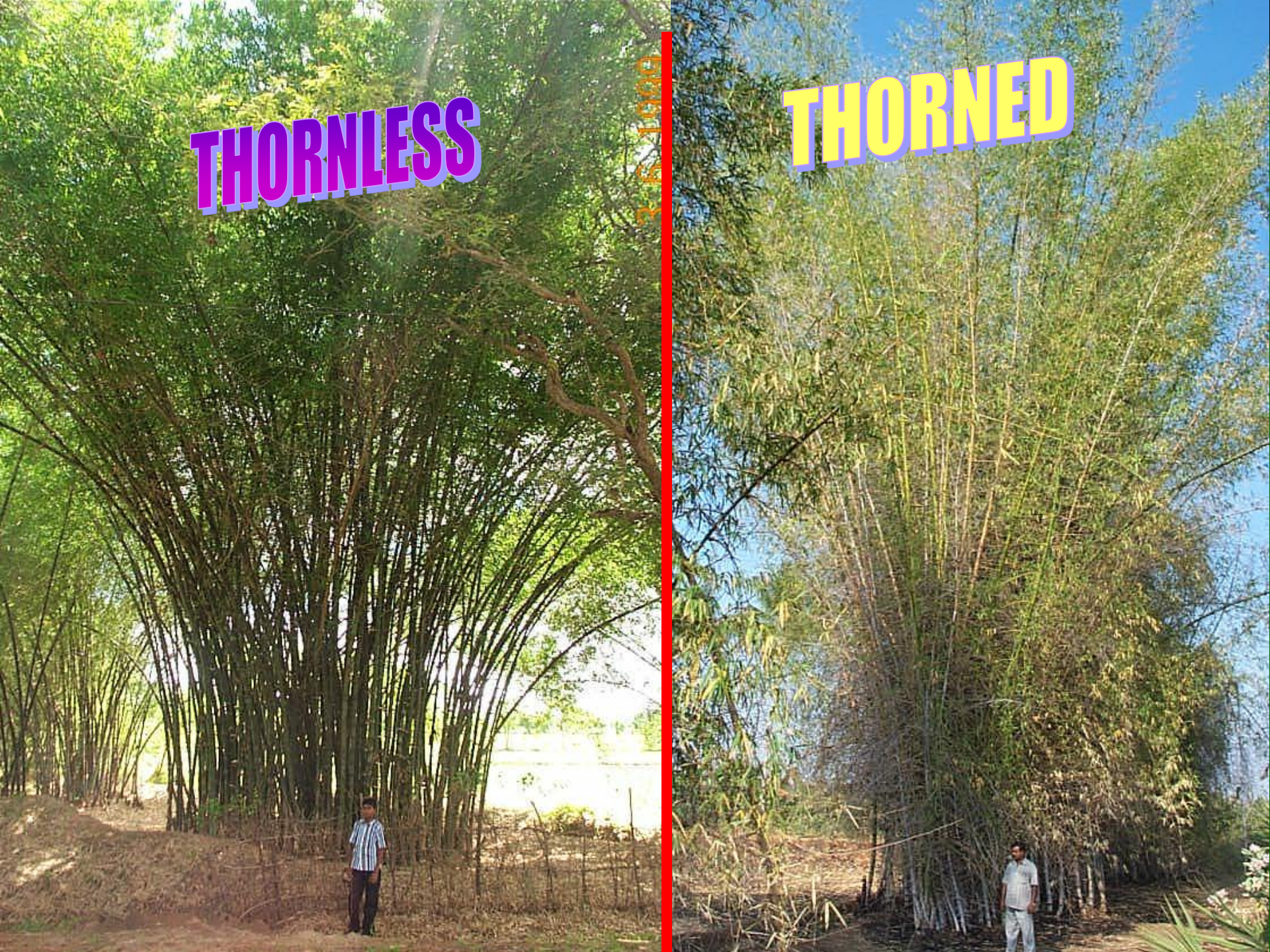
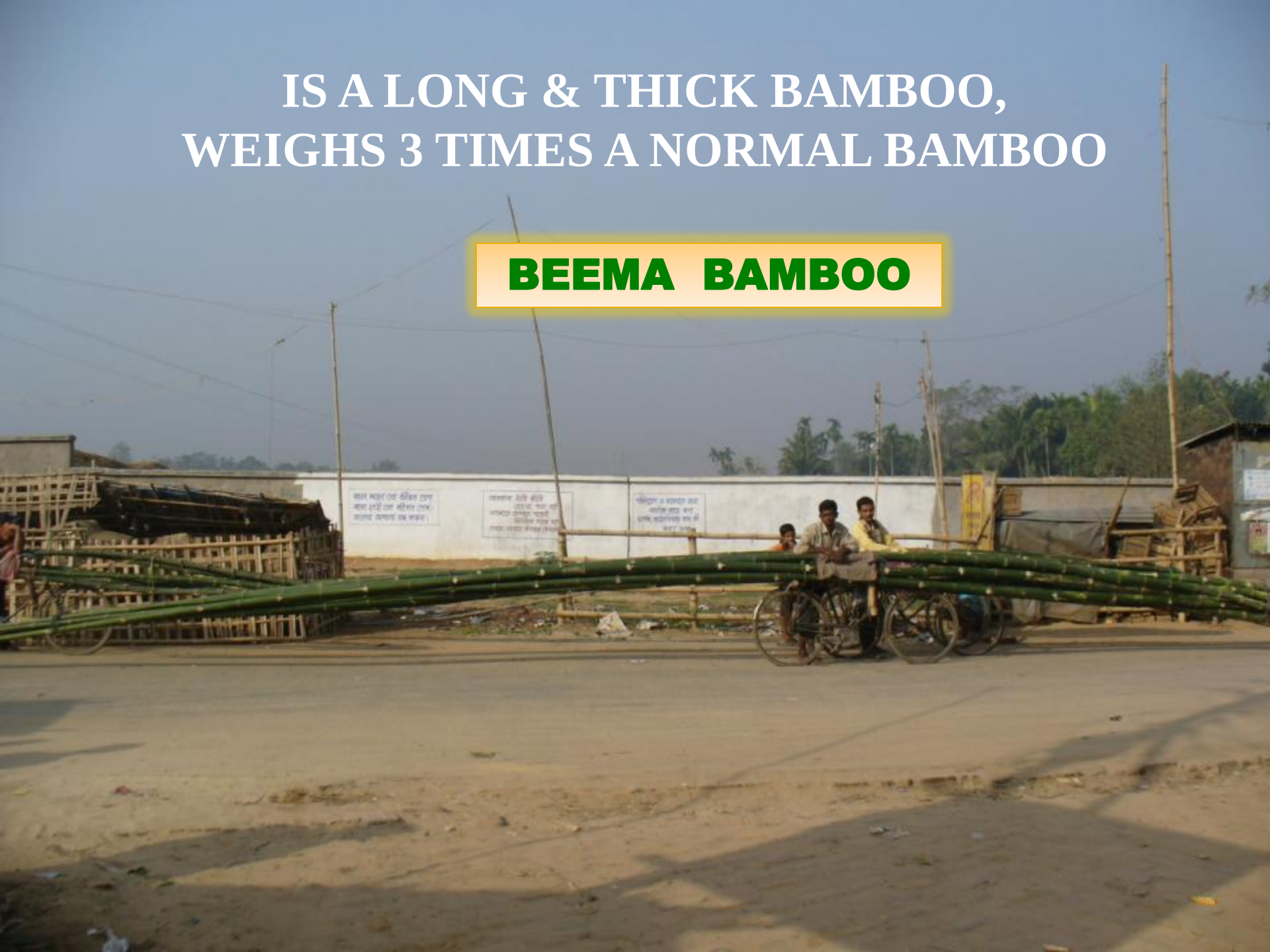

THORNLESS
THORNED

# BEEMA BAMBOO


IS A LONG & THICK BAMBOO,
WEIGHS 3 TIMES A NORMAL BAMBOO
BEEMA BAMBOO


BEEMA BAMBOO
BEEMA Bamboo is one of the cultivated bamboo with very thick wall, highly Suitable for biomass plantation for intensive cultivation

BEEMA BAMBOO

Wild BAMBOO


BEEMA BAMBOO


Bamboo Flowering and
Death of the tree
Beema bamboo is sterile and
does not die for over century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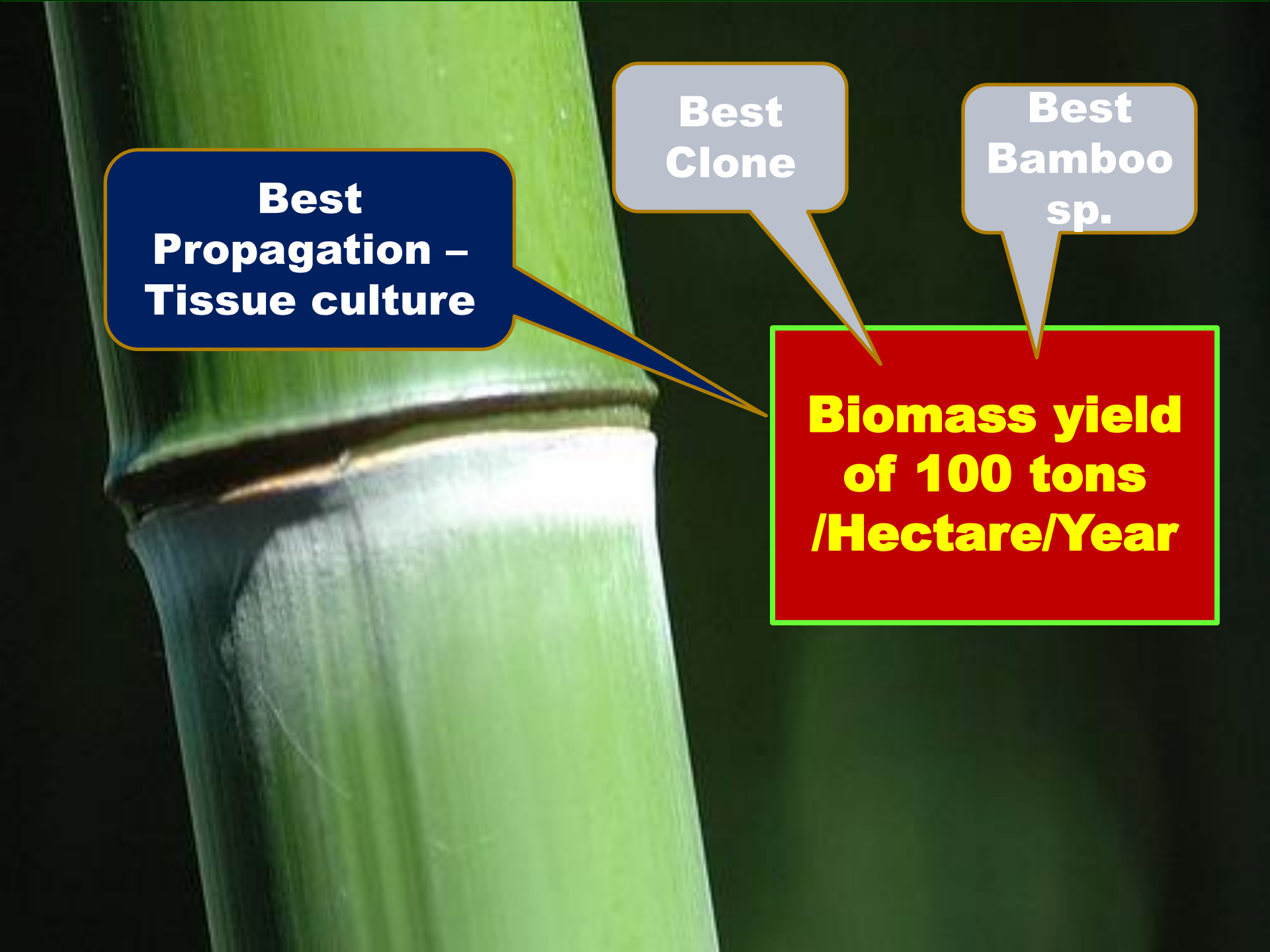
QUALITY
PLANTING
MATERIAL
GROWMORE BIO-TECH
LTD.


Best Propagation – Tissue culture
Best Clone
Best Bamboo sp.
Biomass yield of 100 tons /Hectare/Year

# BAMBOO TISSUE CULTURE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# INITIATION



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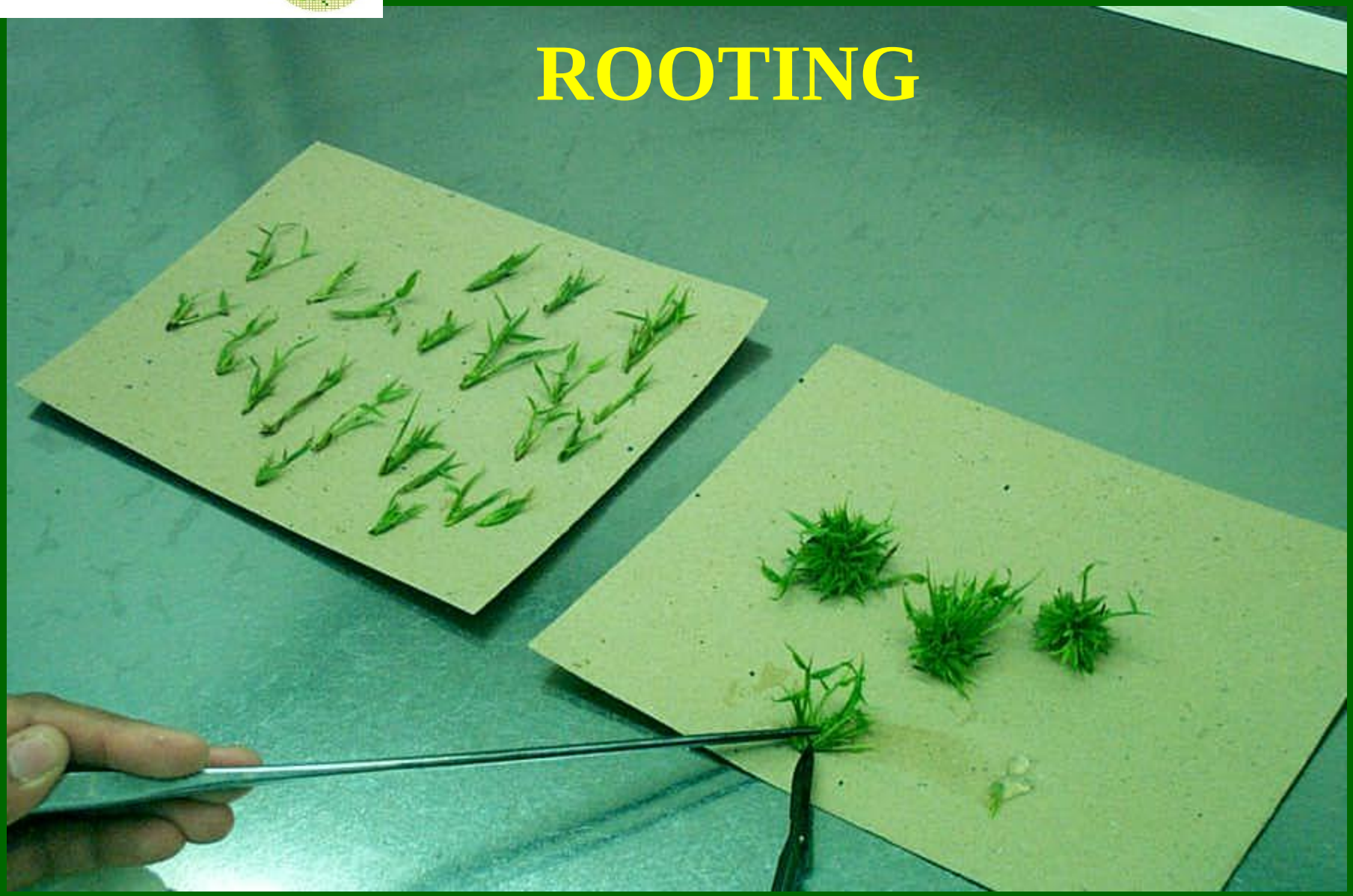
# INITIATION

# BAMBOO TISSUE CULTURE

# MULTIPLICATION

# ROOTING




Bamboo culture production line of 100,000 plants / day

# Tissue Cultured Bamboo plants in the GreenHouse

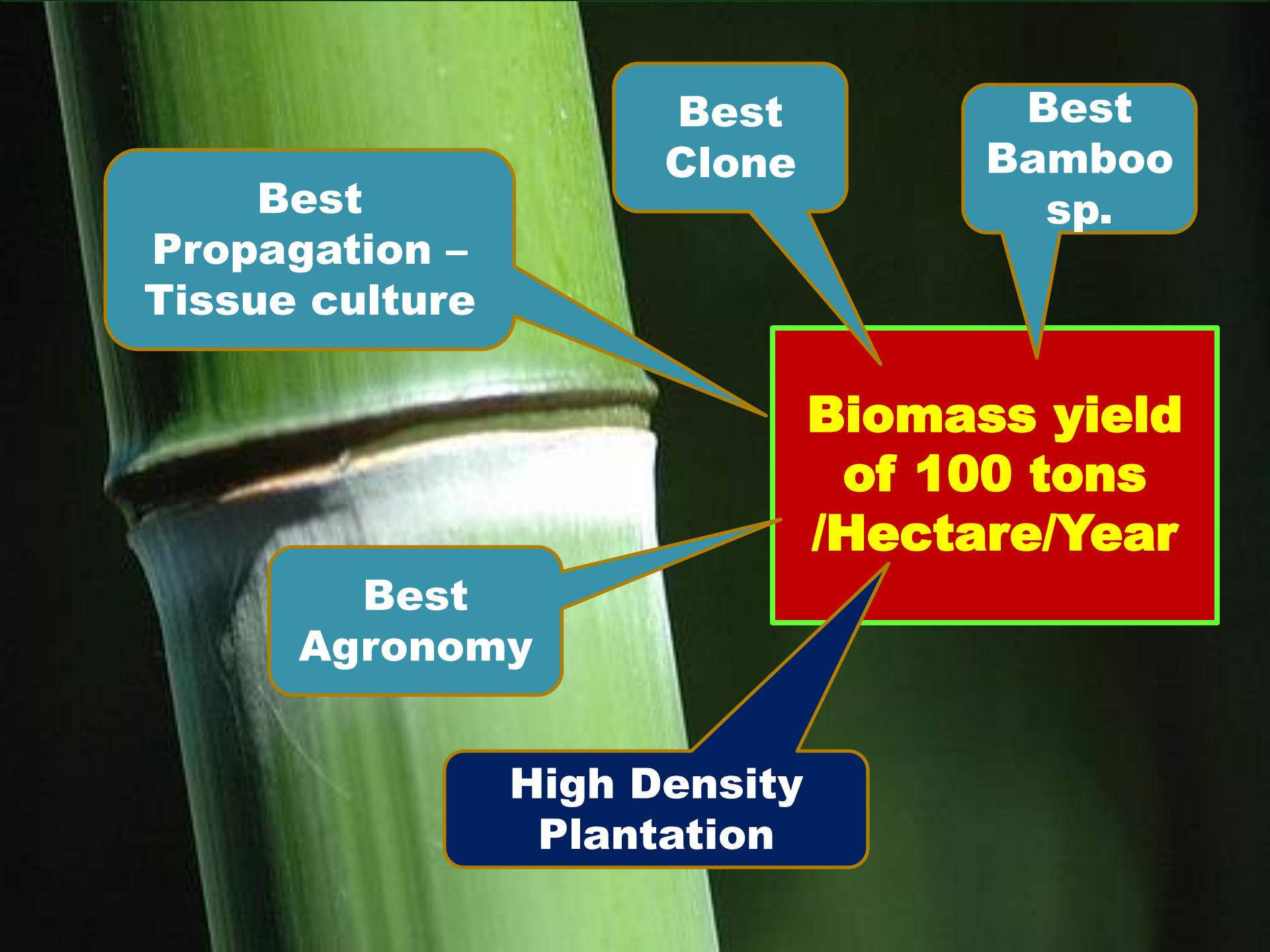
# Tissue Cultured Bamboo plants

# Tissue Cultured Bamboo plants in the GreenHouse

# Tissue Cultured Bamboo clone ready for export


90 days old in polybag
Best Quality
Tissue Culture Bamboo
For Field Plantation

# 4. Best Practices in Bamboo Plantation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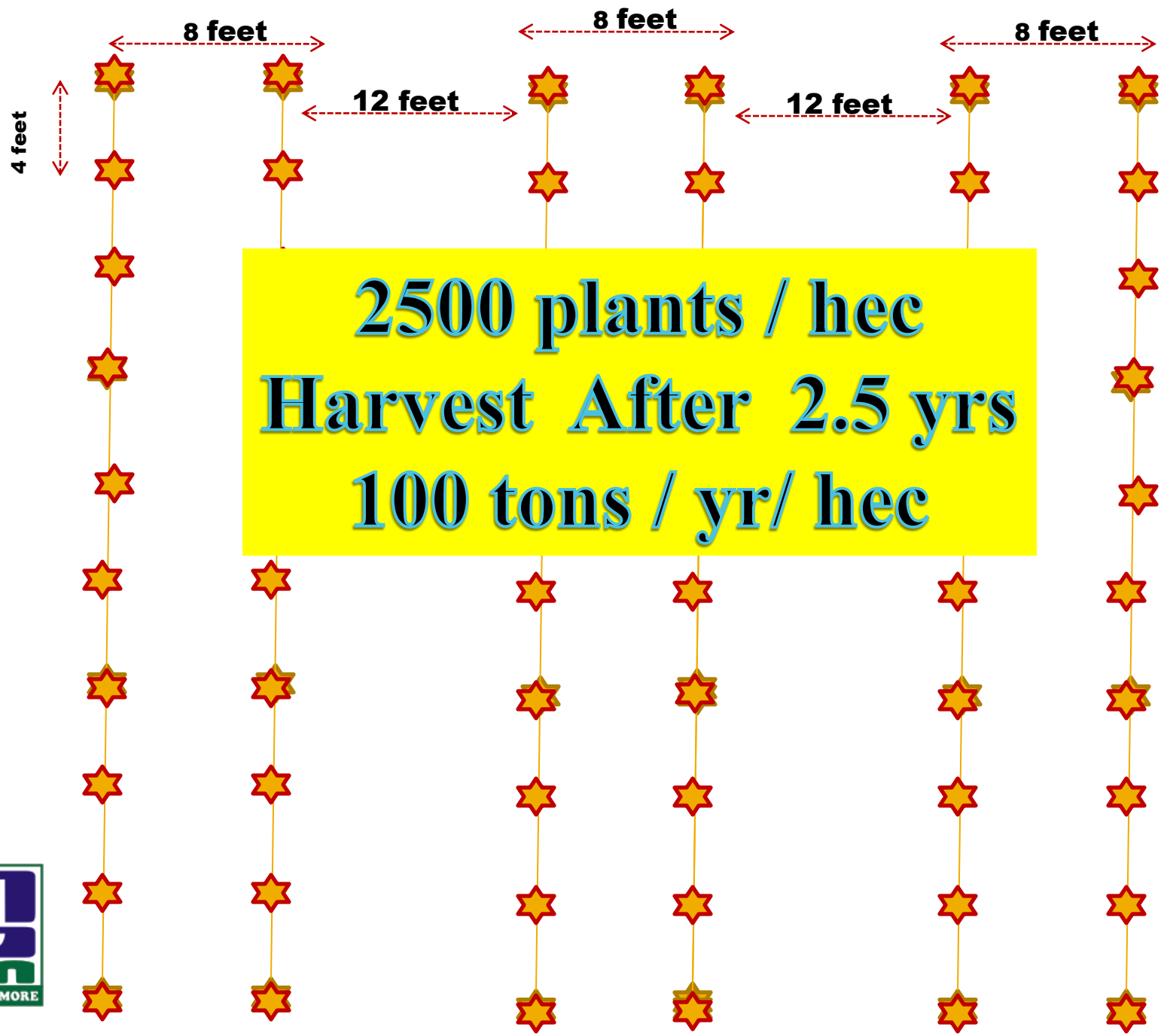
8 feet
8 feet
8 feet
12 feet
12 feet
4 feet
2500 plants / hec
Harvest After 2.5 yrs
100 tons / yr/ hec
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# Fertigation tank

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# 4 months old Beema Bamboo

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# 8 months old Beema Bamboo


12 months old Bamboo


12 months old Bamboo
8 feet
12 feet


12 months old Beema Bamboo


10 months old Eucalyptus

# One year old Beema bamboo

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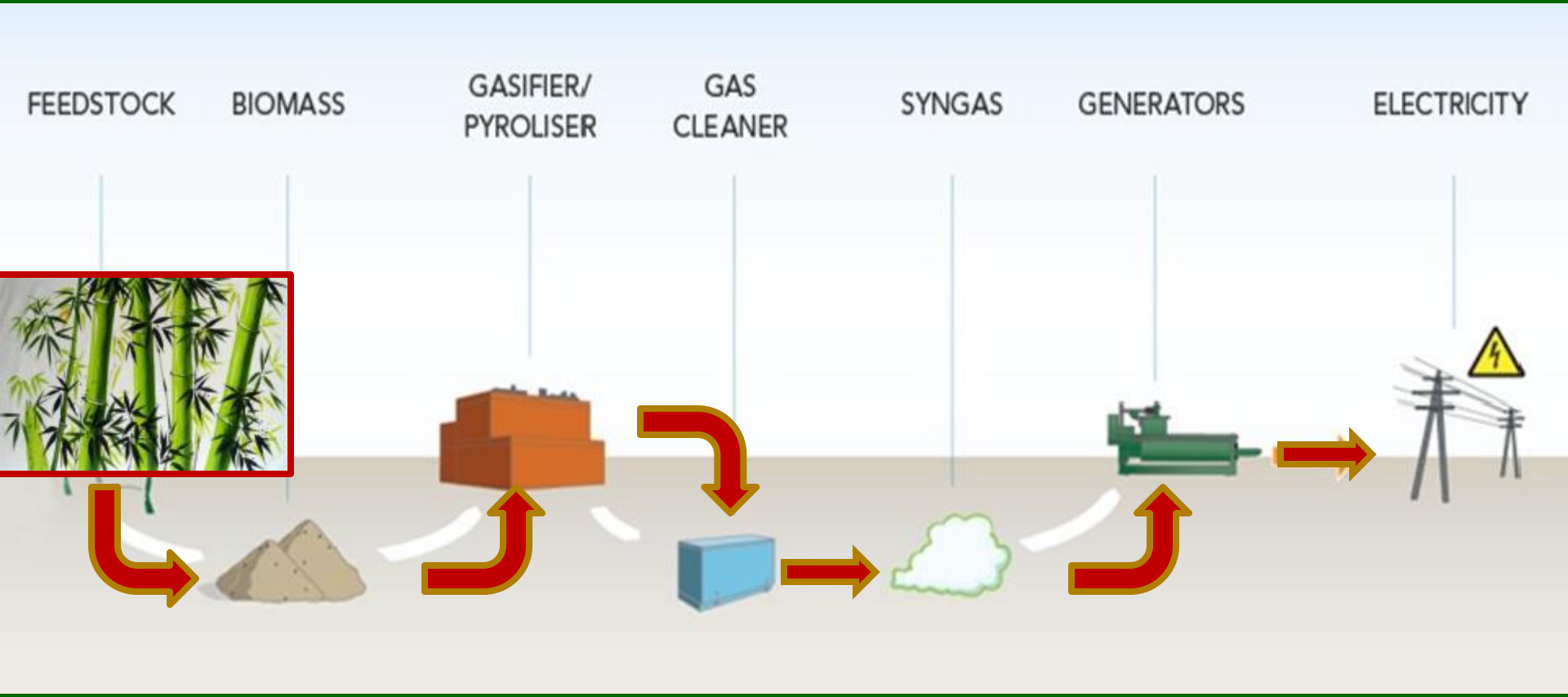
# Plantation to Green Energy



# Portable Gasifier – 5 KW / hour


Bamboo Gasifier
– 500 KW / hour

ENERGY PLANTATION

200 ac

BIOMASS

PYROLYSIS

PRODUCER GAS AND BIOCHAR

POWER UNIT

1 MWh

**8000 MW HOURS /YEAR**

charcoal


premium bamboo charcoal
BAMBOO CHARCOAL AIR FRESHNER


premium bamboo charcoal
BAMBOO CHARCOAL AIR FRESHNER

# Decomposition of Leaf Litter and nutrient release in a bamboo plantation

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Vermicomposting bed

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# Vermicomposting bed

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# Bamboo Vermicompost

# Insitu Vermicompost of bamboo leaf

- Bamboo leaf litter from plantation act as a very good manure on its decomposition.
- Vermicompost is a high-grade, nutrient-rich plant fertilizer helps to increase the physico-chemical properties of soil.
- Worm composting adds additional input by improving the soil health.

# This project has both a commercial and non-commercial value

- Mitigate the effect of pollution, carbon dioxide emissions and water pollution.

- Potential Reclamation of property. Cleaning up of industrial wasteland and improving the quality of water.

- Reducing pollutants in the air through carbon retention and generation of carbon credits

- The generation of economic activity and upgrading of local community, skills development and job creation through the cultivation of the crop and resultant establishment of down stream industries.

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# THANKING YOU


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