

# BIOCHAR SOIL IMPROVEMENT



**WHY BOTHER? WHAT CAN IT DO FOR YOU? HOW DO YOU MAKE IT?**

# YOUR MOST VALUABLE ASSET IS YOUR SOIL



# BUT WHAT'S THE REAL TRUTH ABOUT FARMING IN NORTH THAILAND?



Our soils are terrible. They are...

- Nutrient Poor
- Compacted
- Poor at Water Absorption/Water Retention
- Too Acid (Very Low pH)
- Deficient in Organic Matter
- Dead with No Soil Life – Microbes, Fungi, Worms

# WHAT NUTRIENTS ARE MISSING?



## Big 3 Macronutrients

- N nitrogen
- P phosphorous
- K potassium

## 2<sup>nd</sup> Tier Macronutrients

- Ca Calcium
- S Sulfur
- Mg Magnesium

## Key Micronutrients

- B Boron
- Cl Chlorine
- Mn Manganese
- Fe Iron
- Zn Zinc
- Cu Copper
- Mo Molybdenum
- Ni Nickel

*Our soils are lacking in all of them!*

# SO WE FERTILIZE, EXCEPT...

- Chemicals are expensive and 50%+ wash away in the first rain
- Standard NPK does not supply the other required macro- or micro- mineral nutrients
  - What if you had to live on a diet of eggs, rice and bananas?
- Minerals are only half of what a plant needs to eat. The other half - organic matter - cannot be supplied by synthetic fertilizers.
- Chemicals do not solve any of your other problems

# WHAT ARE YOU DOING ABOUT THE OTHER PROBLEMS?

- **Plowing To Break Up The Soil**
- **Maybe Liming**
- **Irrigating**



# SO WHAT'S WRONG WITH THAT?

- Plowing creates deep compaction that roots cannot penetrate
- You have to lime every season because the lime only works for a little while and runs off with the rains
- You have to use a huge amount of water because much of it runs off the hard surface of your soil and never soaks in – and when it runs off, it takes a lot of your fertilizer with it

# BIOCHAR SOIL AMENDMENT CAN SOLVE ALL OF THESE PROBLEMS

## Used Properly, Biochar Can:

- Improve soil structure
- Improve water penetration
- Improve water retention
- Increase pH (make your soil less acid)
- Increase soil life (microbes, fungi, worms)
- Increase organic matter (the other half of plants' diet)

## And...

- It's free
- You can make it yourself



# WHY NOW? CLIMATE CHANGE AND YOU

**What's happening to the weather? What's happening to the rainy season? What's happening to the rains?**

- The weather is getting hotter.
- North Thailand is getting drier.

**The rainy season is getting later and less predictable.**

- When rain falls we get big storms and floods that rush off down the river leaving nothing behind in the ground.

**These conditions will continue to get worse and worse.**

- If we do not change how we farm now, climate change will soon destroy agriculture in North Thailand



# WHY NOW? – MONEY

## Thailand just joined ASEAN.

- Thai farmers make less money for every ton of rice or fruit or vegetables they raise than farmers in any other ASEAN country.
- Why? Because you spend so much money on chemicals!



# WHY NOW? – YOUR MONEY

- A woman I met in MaeJo is selling compost for 30 THB per kilogram
- At this price you can sell biochar for at least 30,000 THB per ton.

## Think about it.

- Our training is about stopping smoke.
- But this is about why stopping the smoke is not a burden, it is a business opportunity for...
  - Farmers
  - House wives
  - Tambons
  - Clinics



If you have leaves, straw, stalks, wood chips, etc, you can make biochar ***and make money.***

**This is different from the usual anti-smoke training.**

# SOIL STRUCTURE AND WATER RETENTION



## What is the problem?

- **Our soils are mostly clay**
  - They are dense, heavy when wet, hard when dry
  - Water just runs off when it rains or we irrigate

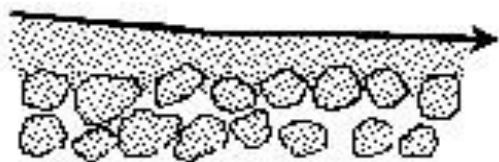
## Result?

- Poor water penetration.
- Poor fertilizer penetration.
- Poor water retention.
- Floods down stream.
- No water early in the dry season, poor crop growth.

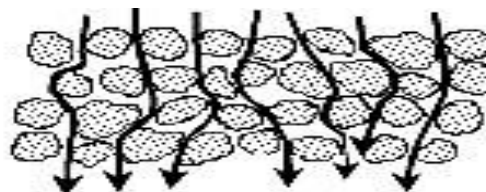
# BIOCHAR, SOIL STRUCTURE AND WATER RETENTION

**Biochar added to soil, even clay, makes the soil more porous**

- Water will penetrate porous soil more easily



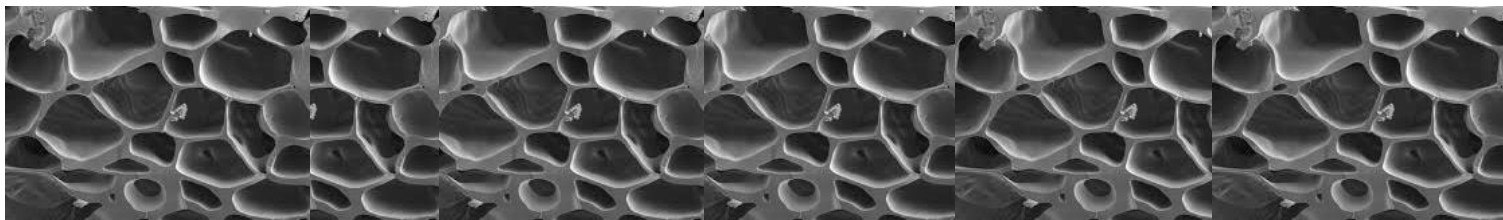
Water runs off hard packed clay



Water penetrates easily where biochar particles have made spaces

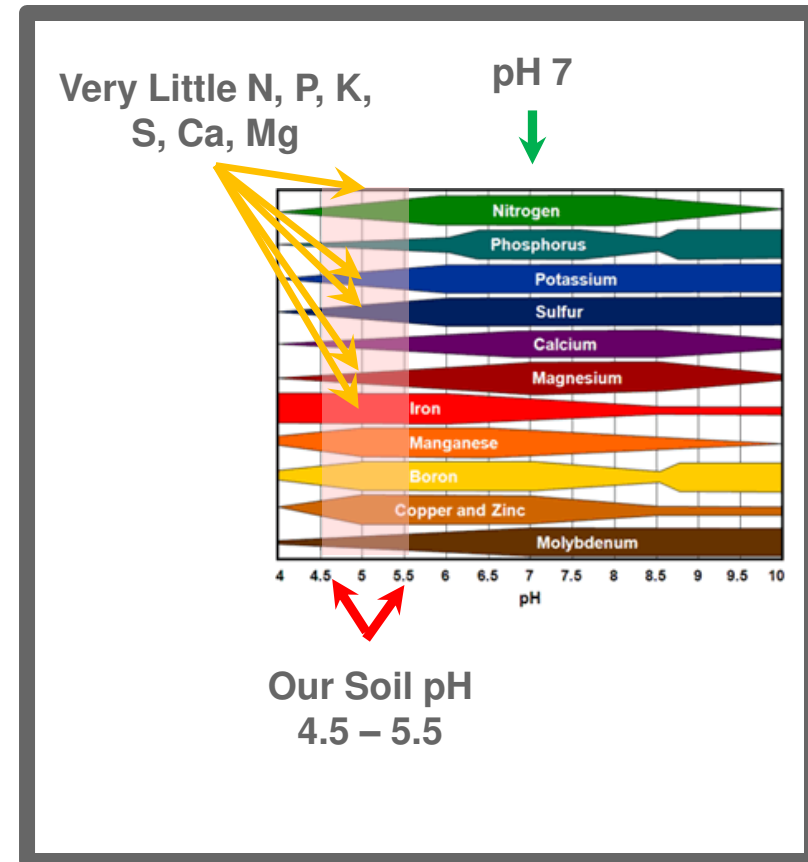
**Biochar in soil will absorb lots and lots of water**

- Wet biochar holds enough water to add two extra days between waterings



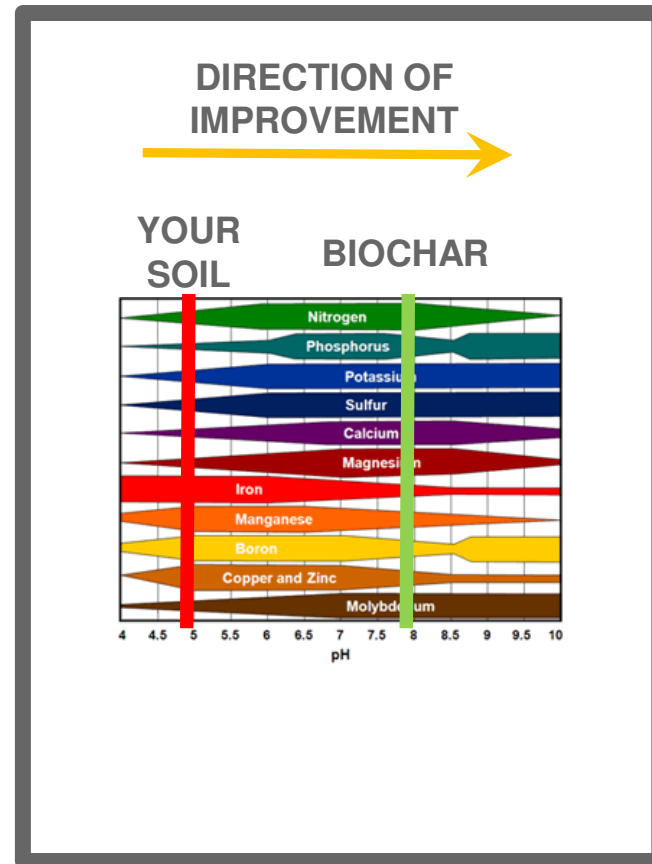
# SOIL pH AND YOU

- pH measures how acid your soil is
- pH runs from 1 (acid) to 14 (alkaline)
- A pH of 7 is neutral and most plants like soil that is around pH 7
  - They grow best at pH 7 because all of the nutrients in the soil are available to them.
- Our soils are very acid – pH 4.5 -5.5
- In acid soils the most important nutrients are **not** available to plants.



# BIOCHAR, pH AND NUTRIENT AVAILABILITY

- Biochar has permanent pH of 8
- Adding biochar raises soil's pH in the direction of 8
- Raising the pH unlocks access to many nutrients in soil
- We will teach you how to make biochar fertilizer with pH 10!



# SOIL LIFE AND YOU

**Healthy soil is alive with microbes, fungi and worms**

- Live soil feeds your plants

**Plants cannot eat N, P, K or other mineral nutrients; they need soil life to eat them first – then pee!**

- You plants take up bug pee

**Soil life needs oxygen**

- Worms and fungi open the soil to let the air in





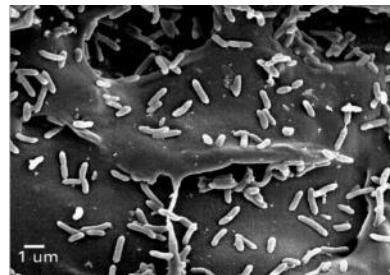
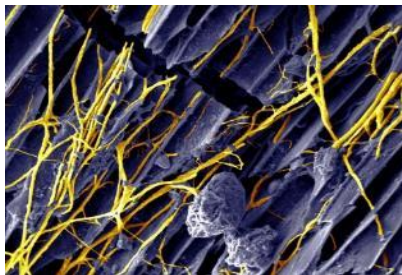
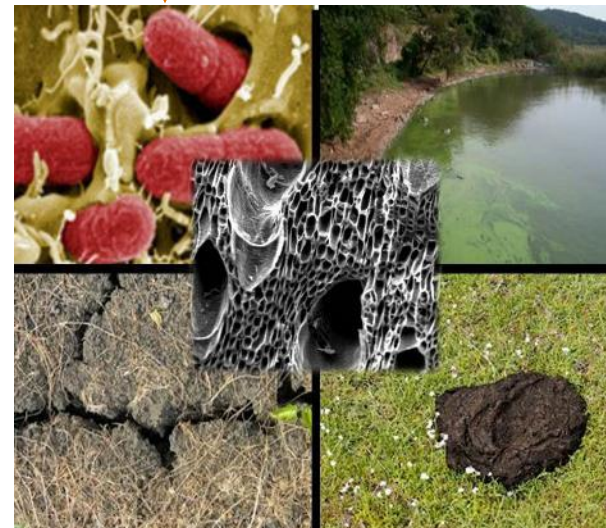
# BIOCHAR AND SOIL LIFE

- Tiny holes in the surface of biochar make nice condos for soil life.
- The minerals on the surface of biochar particles attract many types of soil life.
- Microbes colonies that develop around biochar particles control the growth of microbes that make plants sick.
- The microbes and fungi attract worms that make holes in the soil to bring oxygen underground.



*Tiny fungus grows on the biochar surface*

*The best of bug condos*



*Microbiota on surface of biochar seen through scanning electron microscope*

# SOIL ORGANIC MATTER AND YOU

- Organic matter is dead stuff, plant or animal, that is rotting
- Organic matter provides food and living space for microbes, fungi and worms.
- The microbes, fungi and worms turn organic matter into food that your plants can take up.
- Organic matter should be 2-10% of soil; not less than 1.3%
- Our soil typically has less than 1.3%, often less than 1%.



# BIOCHAR AND SOIL ORGANIC MATTER

- Where we live organic matter rots quickly because in the heat the microbes and fungi grow rapidly and eat fast.
- With rapid decomposition, much of the potential nutrition is lost before plants can take it up.
- When the organic matter is gone, more must be added to the soil or the soil (and plants) will die.
- But if we have mixed biochar into the compost and soil the nutrients stick to the biochar and stay.

# BIOCHAR FOR SOIL IMPROVEMENT



Biochar itself is NOT fertilizer. In fact, if you put it into your field right after making it, your plants may die.

**ALWAYS** – always age your biochar for at least three months before you use it.

Biochar to **IMPROVE SOIL** – To get the biggest effect from your biochar, mix it with what your soil needs. The biochar will make it better and it will make the biochar better.

- Pour as much pig pee on your biochar as it will absorb. (If you do not have pigs, any kind of pee will do, even yours!)
- Mix biochar, good compost and manure 1:1:1 (If you do not have compost or manure, substitute the other.)
- Spray well with EM and mix, spray again and mix again
- Cover the pile and let it sit for 3 months.

# USING BIOCHAR TO IMPROVE SOIL

- **Potting mix** – add a few handfuls to your normal recipe (Do not overdo it. Biochar retains a lot of water and if you are not careful you will have problems with damping off.)
- **Planting seeds** – make hole, add small handful of biochar mix, cover with dirt, place seeds, cover with dirt, sprinkle a small handful of biochar fertilizer on top
- **Planting seedlings or trees** – dig large hole, replace one half of the dirt with biochar mix, toss 2-3 handfuls of biochar mix at the bottom of the hole, plant
- Planting rice, each rai:
  - **Nursery bed** – mix 5 kg of biochar mix into mud at least 2 weeks before planting seeds
  - **Paddy** – mix 800 kg of biochar mix into mud at least 2 weeks before replanting for four years (benefits in year 1)
  - **Orchard trees** – spread 10 kg of biochar mix in a shallow trench around tree at the “drip line”, cover with dirt, repeat every 3 months

# BUT DOES IT WORK?



Biochar alone      No fertilizer



Biochar + NPK      No fertilizer



NPK alone      Biochar + NPK



Biochar alone      NPK alone

# SO WHAT CAN BIOCHAR DO FOR YOU?

- Biochar is a simple way to enrich your soil.
- In the short-term and increasingly over the long-term, it will improve your yields.
- It will improve your soil in every way and will help to prepare you for the risks of climate change.
- Used properly and regularly, biochar can help you:
  - Manage your water needs better;
  - Reduce your costs; and
  - Improve your yields and income.



# BIOCHAR IS NOT MAGIC...

*But it's better than anything else!*

## **Biochar Takes Work But It Will...**

- Pay you for your work.
- Make you and your family healthier.
- Ensure that your land will remain productive into the future.



# CONTACT INFORMATION

## WARM HEART FOUNDATION

info@warmheartonline.org  
www.warmheartfoundation.org

Warm Heart Foundation (CM 273)  
61 M.8 T.Maepang A.Phrao 50190  
Chiang Mai, Thailand

*This training was brought to you as part of the “A Breath of Fresh Air” grant funded by the United States Department of State.*

