

Understanding Tropical Soils: Part 1

by Dexter B. Dombro



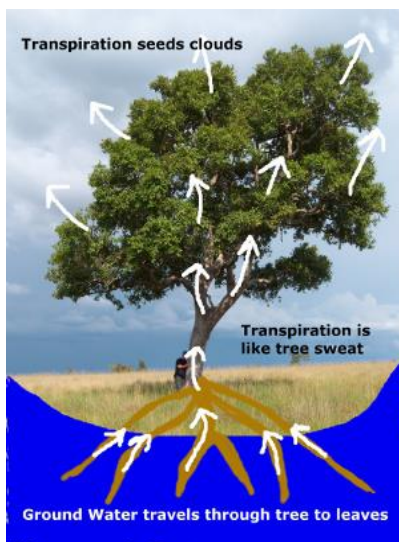
Tree plantation in sandy, acidic soil in the tropics.

Tropical forests are the lungs of our planet. 95% of all tree-based carbon sequestration occurs in the tropics, primarily between both 15° northern and 15° southern latitudes from the equator. The huge forests of Canada, Russia and Scandinavia and other temperate zones only account for 5% of tree-based carbon capture. This means that the decline of tropical forests is a huge cause of climate change. Many studies show that tropical deforestation emits greenhouse gases (GHG) and may well be the leading cause of desertification of the Earth. All trees play important roles in removing CO₂ from the atmosphere, but also other dangerous contaminants. They help hold ground water and thanks to the process of transpiration are crucial for cloud seeding and the maintenance of global rainfall patterns. Needless to say, forests also account for 90% of terrestrial biodiversity, making them essential habitats for life on our planet.

However, planting trees, especially tropical trees, involves more than just sticking a seedling in the ground. Tropical soils are often poor and acidic, in large part due to millennia of torrential rains that have leached the nutrients and organic material out of the soil, a process called lixiviation. For example, the grasslands of eastern Colombia (*llanos orientales*) and Venezuela have soils that are mainly composed of sand, ferrous oxide gravels and some clay. Similar conditions exist in large parts of Brazil and in the Amazon basin. This is why Amazon deforestation is such a huge problem: poor people cut down trees to grow subsistence crops, collect one harvest and then find that the soil is depleted, so they repeat the process, cutting down more rainforest. Unfortunately, this is the definition of insanity, doing the same thing over and over again, expecting different results each time.



Deforestation in the tropics has climate change implications for the whole planet.



Transpiration by trees helps to seed clouds.

I don't want to bore you, but it is important to understand two key issues involving tropical soils. The first issue is acidity, measured in a logarithmic scale from 1 to 14, with a pH below 7 being acidic, while a pH over 7 is alkaline. Logarithmic means that each number on the scale is either 10 times more acidic or 10 times more alkaline than the previous number. A pH of 7 is considered neutral and is the value of pure water. Most plants do very well in neutral soils. However, the majority of tropical soils are acidic, which means that native trees and plants have had to adapt to acidic soil conditions. For example, the soil at La Pedregoza in the Orinoco River basin of Colombia has an average pH of 5.1, meaning it is 90 times more acidic than pure water. The traditional agricultural solution to soil acidity is to dump tons of lime on the soil, in order to achieve a more neutral pH, without regard to the cost or the damage done to microfauna.

pH	CE dS/m	CO	N	Ca	K	Mg	Na	Al	CICE	CIC
		%			meq / 100g					
5,1	ns	0,25	0,02	0,13	0,01	0,03	0,04	0,56	0,77	1,85

P	S	Cu	Fe	Mn	Zn	B	Ar	L	A	Textura
mg / kg							%			
<0.7	ns	0,03	3,59	0,19	0,19	<0,12	11	10	79	FA

Typical tropical soil sample. Note the pH of around 5 and the cation exchange capacity (CIC in Spanish) of around 1.

The second issue is something called the cation exchange capacity or CEC of the soil. For simplicity's sake this is best described as the capacity of the soil to retain nutrients, be that organic material, microfauna or fertilizers. CEC is measured on a scale of 0 to 50, with 0 being soil that has complete filtration or lixiviation of any nutrients, making for rapid drainage with no retention of any kind. In contrast, soil with a CEC of 50 is solid rock or hard clay, which does not allow for drainage, causing plants and their roots to drown. In the case of tropical soils the majority have a very low CEC. For example, the average effective CEC of soils at La Pedregosa is around 1, so pretty much total filtration of the soil with very little retention of nutrients, organic material or microfauna. This explains why rainforest trees are complete recyclers, drawing the majority of their requirements from the atmosphere and from the deadfall of leaves, branches and other organic matter inside the forest. They have very little dependence on the soil for their food requirements. Now you know why rainforest deforestation in the tropics produces such poor agricultural results.

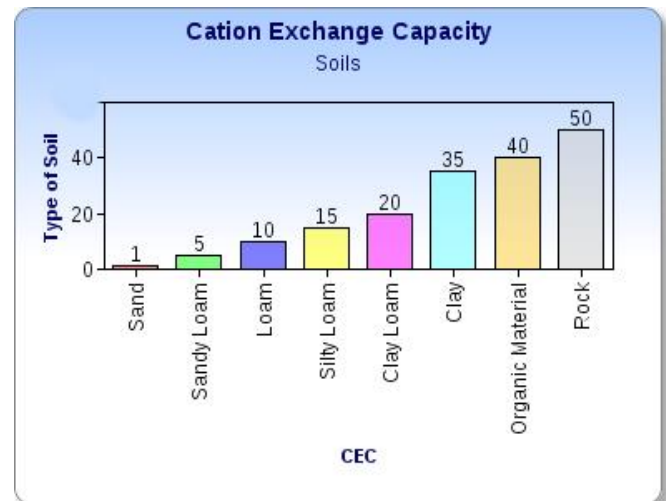


Illustration of how the cation exchange capacity scale for soil works.

In Part 2 of this series of articles, I will address the most promising solution to the nutrient retention and acidity problem in tropical soils. That solution has positive implications for carbon sequestration, plant nutrition, enhanced agricultural and agroforestry production, is financially sustainable and has huge socio-economic development benefits in tropical regions. It is also 100% organic and natural, without any chemical or artificial elements.