What is the Most Important Impediment to our Knowledge about Agrichar?

Clear Process Models Are Not Available

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BEST ENERGIES AUSTRALIA
ESSENTIAL TECHNOLOGIES POWERING BIOFUELS

THE RESEARCH CHALLENGE

Developing a thorough understanding of how different types of agrichar react in different types of soils, with different types of plants, in different climatic conditions, with different input and tillage practice when they are first put into the soil.

Quantifying how the weathering/aging of the agrichar affects both plant health and growth rates, soil carbon content, water retention and greenhouse gas emissions over the lifetime of the char.

Draft Char Process Model; Food For Thought

Input Seed, Fertiliser, Char and Water

Increase in Soil Porosity, Water Holding Capacity, Decrease in Strength, Water Permeability, Bulk Density, Particle Size Distribution, and Soil Carbon

Time Frame

For High Ash Char Increase in Soil pH around Char Particle and increase in E.C.
For Low Ash Chars Soil is Buffered.

Within First Day

For High Ash Chars Dissolution of Soluble Organic Compounds, Cations and Anions (e.g K,Na, Ca,Cl,S,SO4, PO4)
For Low Ash Chars Dissolution of TOC if Production Temperature Below 550C.

Decrease N2O, and Ammonia Emissions

Nutrient Ions from Fertiliser Exist in Solution in Char Pores.
Adsorption of Nutrient Ions from Fertiliser on Char Surfaces

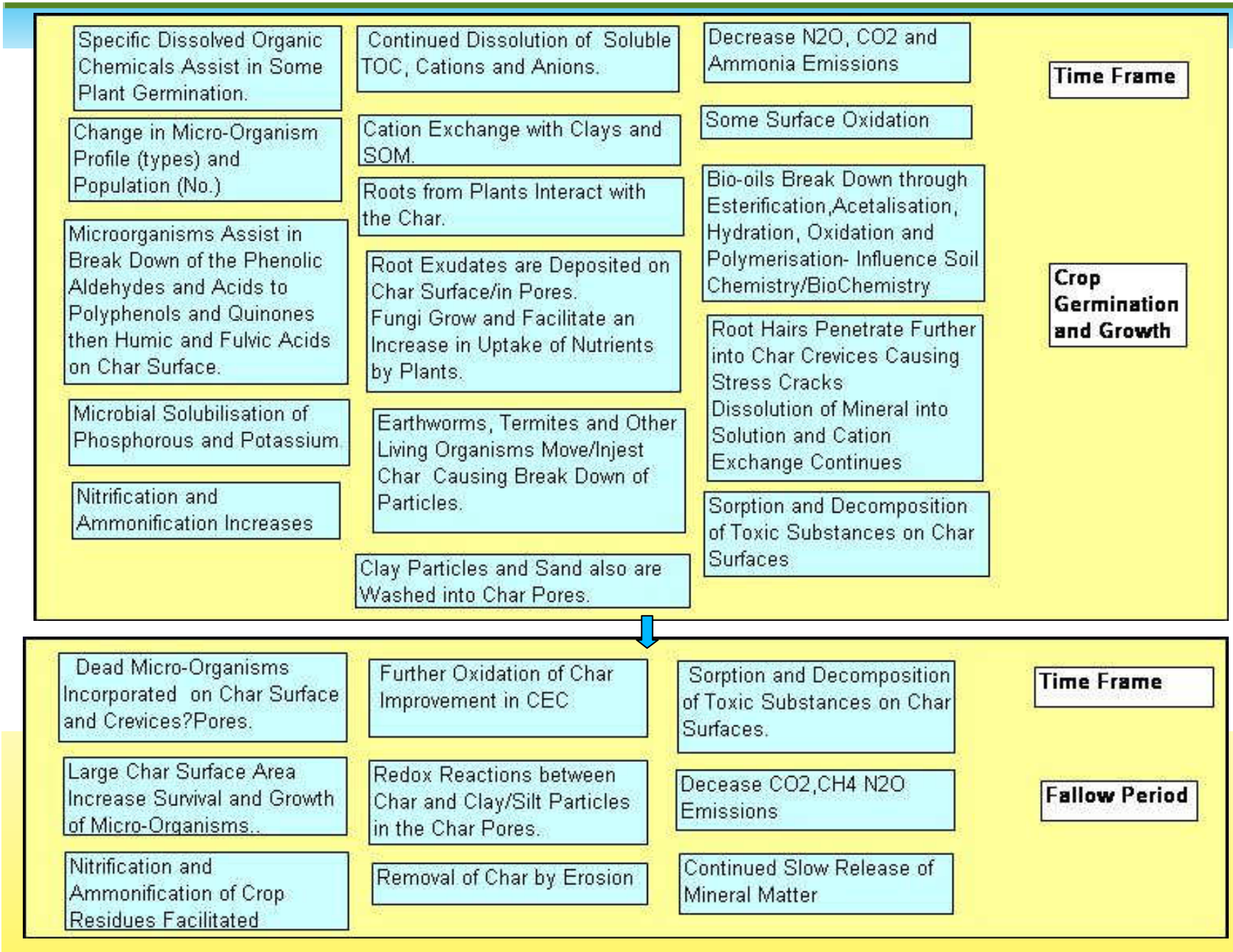
Decreased Nutrient Leaching into Waterways

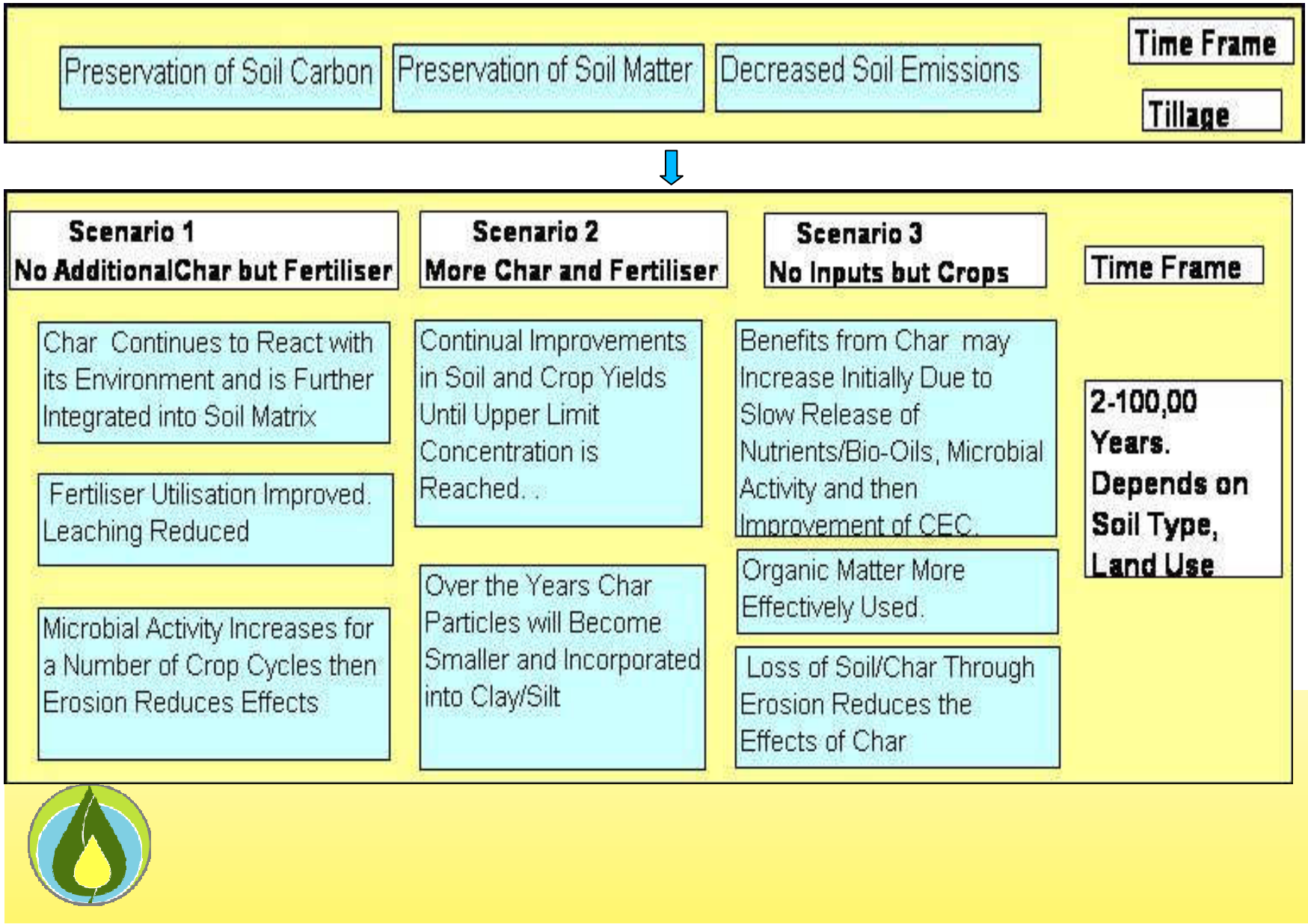
Time Frame

Rain Events

Improved Water Efficiency and Reduction in Erosion

Decrease in Soil Emissions


Specific Dissolved Organic Chemicals Assist in Some Plant Germination.
Change in Micro-Organism Profile (types) and Population (No.)
Microorganisms Assist in Break Down of the Phenolic Aldehydes and Acids to Polyphenols and Quinones then Humic and Fulvic Acids on Char Surface.
Microbial Solubilisation of Phosphorous and Potassium
Nitrification and Ammonification Increases
Continued Dissolution of Soluble TOC, Cations and Anions.
Cation Exchange with Clays and SOM.
Roots from Plants Interact with the Char.
Root Exudates are Deposited on Char Surface/in Pores.
Fungi Grow and Facilitate an Increase in Uptake of Nutrients by Plants.
Earthworms, Termites and Other Living Organisms Move/Injest Char Causing Break Down of Particles.
Clay Particles and Sand also are Washed into Char Pores.
Decrease N2O, CO2 and Ammonia Emissions
Some Surface Oxidation
Bio-oils Break Down through Esterification,Acetalisation, Hydration, Oxidation and Polymerisation- Influence Soil Chemistry/BioChemistry
Root Hairs Penetrate Further into Char Crevices Causing Stress Cracks
Dissolution of Mineral into Solution and Cation Exchange Continues
Sorption and Decomposition of Toxic Substances on Char Surfaces
Time Frame
Crop Germination and Growth
Dead Micro-Organisms Incorporated on Char Surface and Crevices?Pores.
Large Char Surface Area Increase Survival and Growth of Micro-Organisms..
Nitrification and Ammonification of Crop Residues Facilitated
Further Oxidation of Char Improvement in CEC
Redox Reactions between Char and Clay/Silt Particles in the Char Pores.
Removal of Char by Erosion
Sorption and Decomposition of Toxic Substances on Char Surfaces.
Decease CO2,CH4 N2O Emissions
Continued Slow Release of Mineral Matter
Time Frame
Fallow Period


Preservation of Soil Carbon
Preservation of Soil Matter
Decreased Soil Emissions
Time Frame
Tillage
Scenario 1
No AdditionalChar but Fertiliser
Scenario 2
More Char and Fertiliser
Scenario 3
No Inputs but Crops
Time Frame
Char Continues to React with its Environment and is Further Integrated into Soil Matrix
Fertiliser Utilisation Improved. Leaching Reduced
Microbial Activity Increases for a Number of Crop Cycles then Erosion Reduces Effects
Continual Improvements in Soil and Crop Yields Until Upper Limit Concentration is Reached. .
Over the Years Char Particles will Become Smaller and Incorporated into Clay/Silt
Benefits from Char may Increase Initially Due to Slow Release of Nutrients/Bio-Oils, Microbial Activity and then Improvement of CEC.
Organic Matter More Effectively Used.
Loss of Soil/Char Through Erosion Reduces the Effects of Char
2-100,00 Years. Depends on Soil Type, Land Use

Some Concluding Questions

Will All New Chars Replicate the Properties of Terra Preta Over Time?

What is the Relative Importance of Biotic versus Abiotic Processes?

Are Chemical Enhancements Necessary to Ensure the Long Term Stability and Activity of the Char (e.g. addition of Calcium Salts) Especially When Adding Low Ash Chars to Soils?

Recommendation

Research is Required to Generate Sufficient Data To Develop Comprehensive Models.

This needs to be A Global Co-operative Effort

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