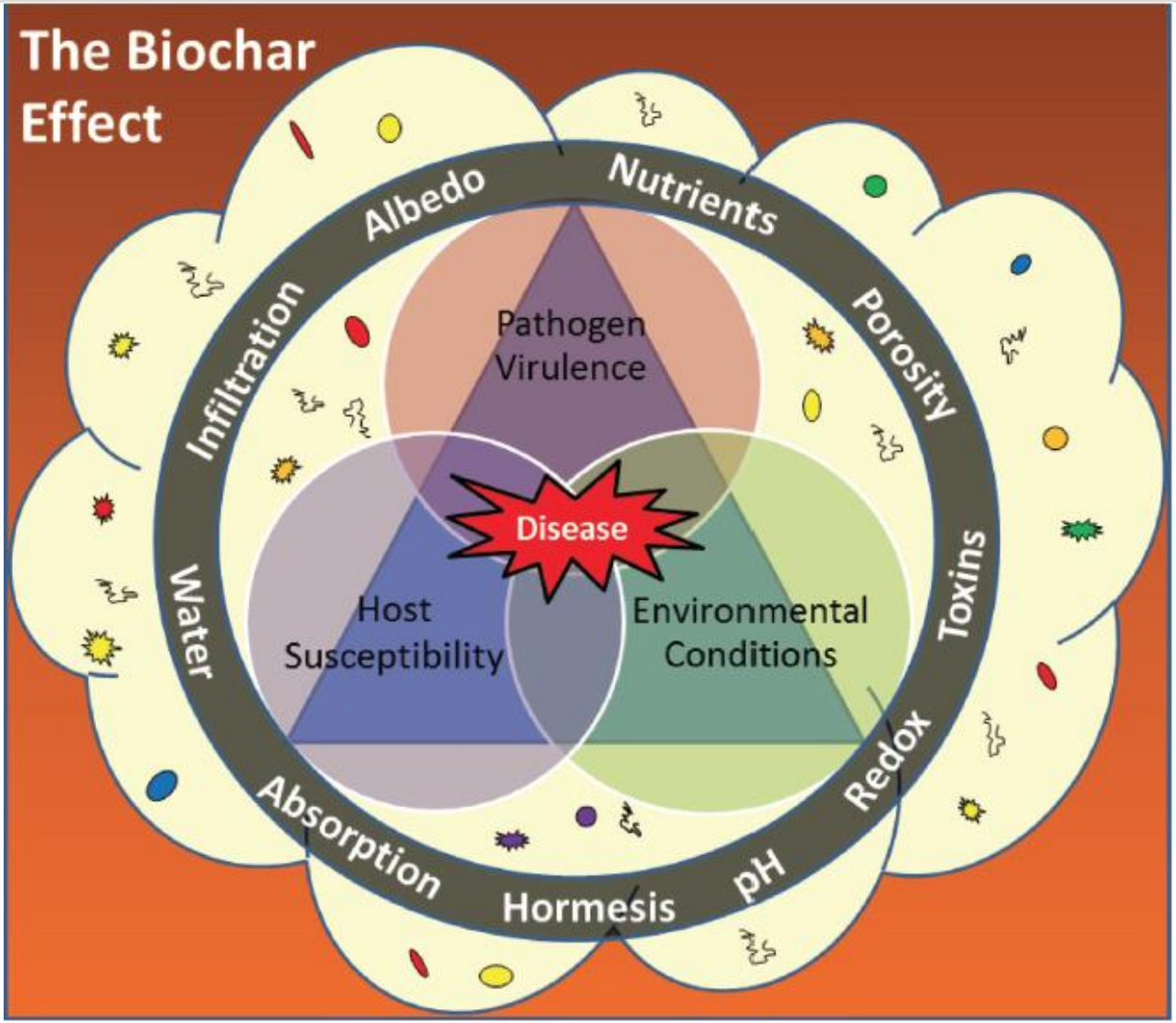
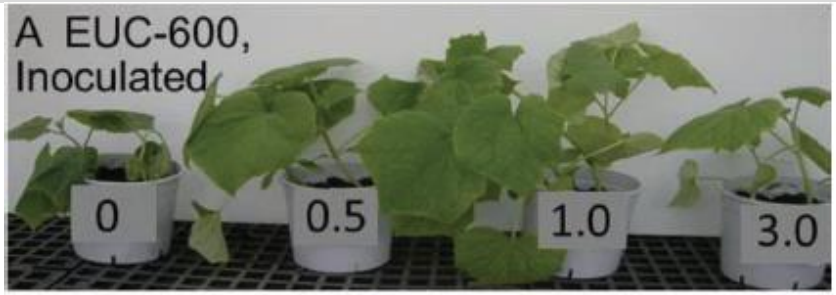
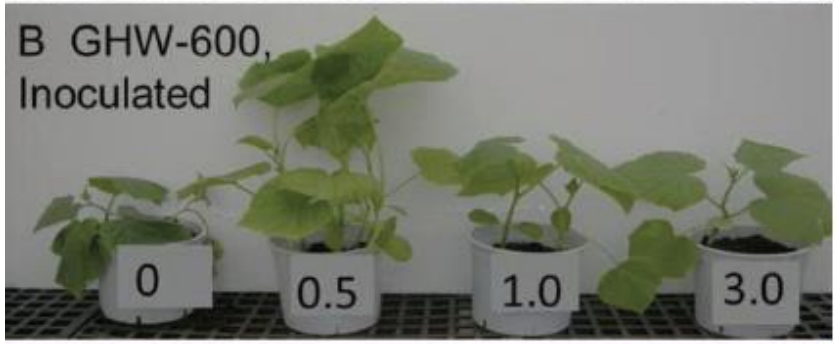
BIOCHAR HELPS PLANTS RESIST STRESS

The Biochar Effect



The Biochar Effect





Resistance of cucumber plants to disease caused by R solani with additions of .5% ,1%, 3.0% of wood biochar produced at 600C after 15 days

Resistance of plant after 20 days when Greenhouse waste biochar 600C after 20 days

Roots after 20 days on plans above

Biochar induces Plant Systemic Responses to Foliar Fungal Disease; Different Biochars can stimulate both pathways or one pathway

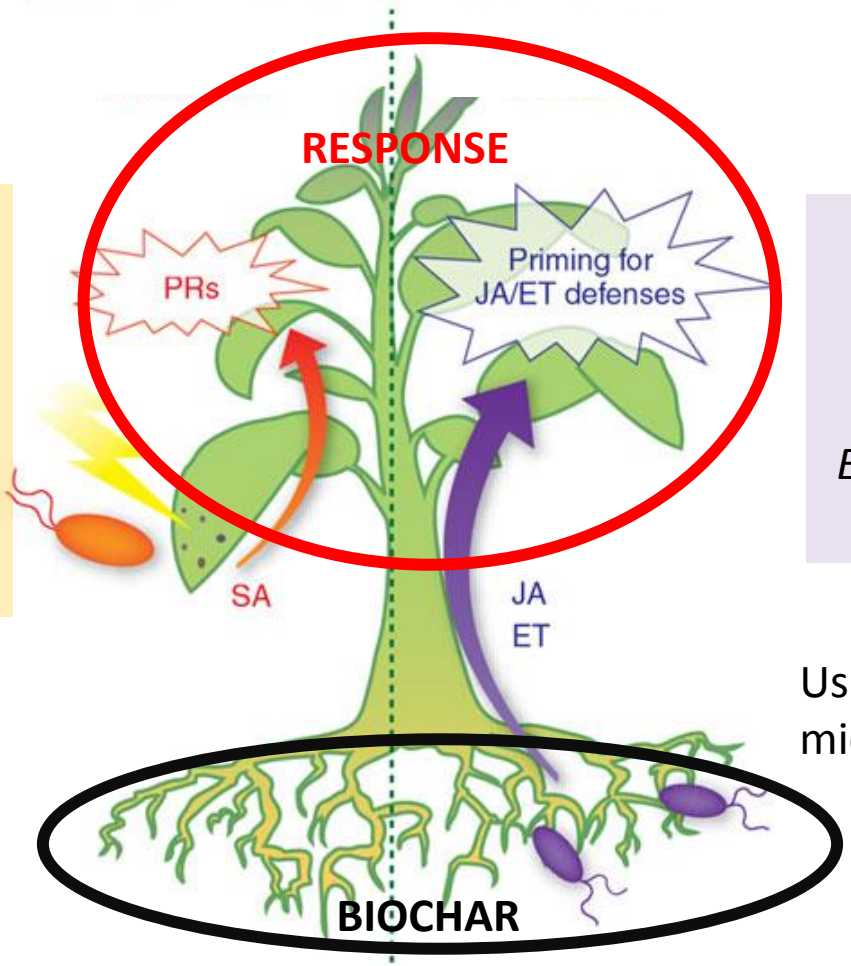
SAR

Systemic Acquired Resistance

Salicylic acid mediated

PR proteins

Usually elicited by chemicals



ISR

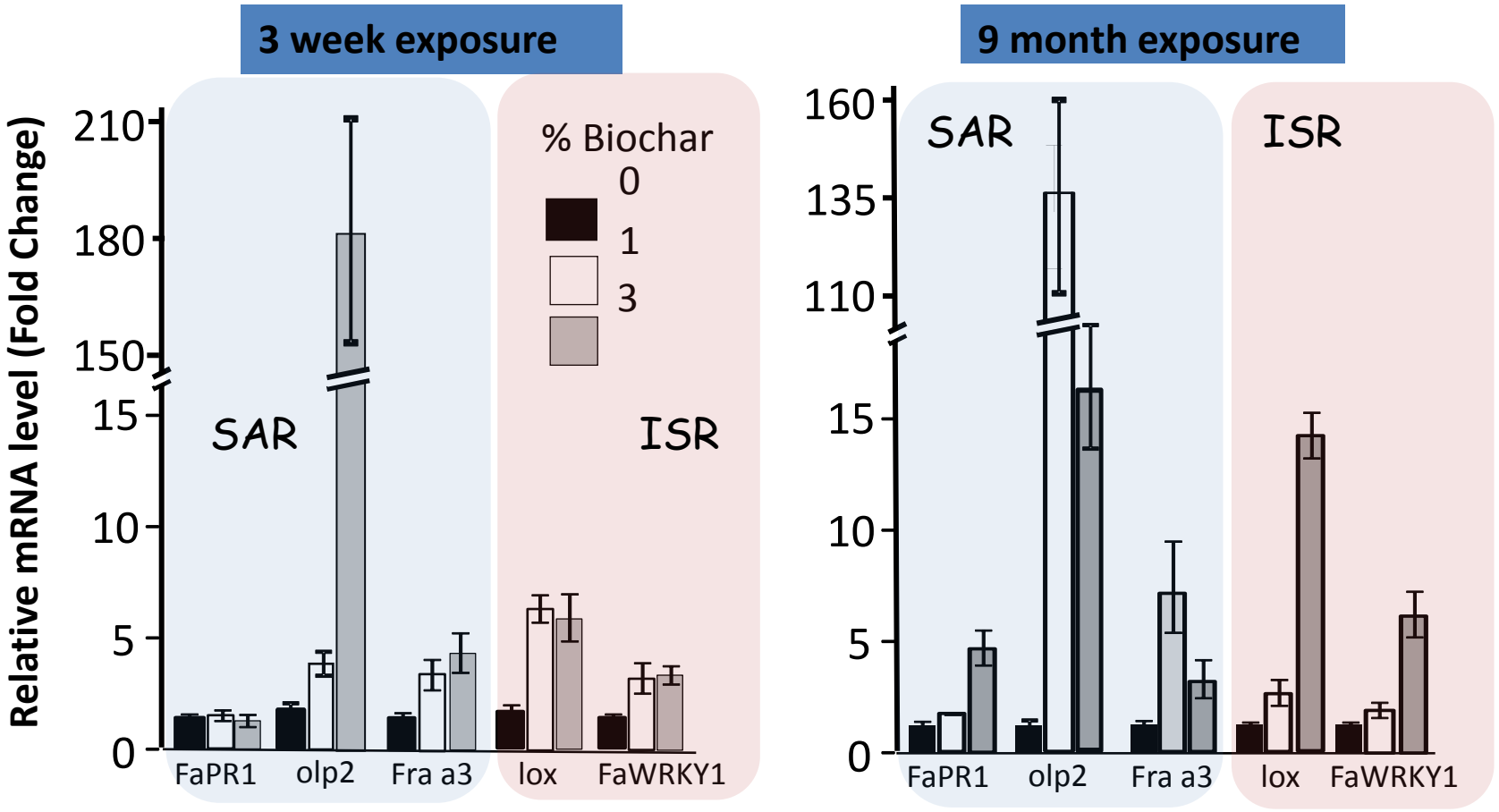
Induced Systemic Resistance

Ethylene/jasmonic acid mediated

Usually elicited by microorganisms

Corné M J Pieterse et al, 2009

Induction of Defense-Related Gene Expression in Strawberry Leaves



Biochar induces upregulation for defense-related genes along both SAR and ISR pathways → can explain broad-based action in numerous systems against pathogens having different modes of attack – necrotropic, biotrophic, semi-biotrophic

Meller Harel et al, 2012 Plant & Soil

Remediation of Salt Affected Land; Experience of Karry Fisher-Watts

Treówstede Brookton

No: 1 Piezometer PVC (52D) - 0.1 – 2040ms/m @ 24m deep under pressure

No2. GAL Pipe 1762 ms/m@ 5m Deep water table 2.4m below surface

pH5.1 , EC .09 dS/m, OC 1.6%, Al .7 (CaCl2)Colwell P 17mg/kg, Nitrate 6mg/kg, Ammonium 1mg/kg

Remediation of Salt Affected Land; Experience of Karry Fisher-Watts

Treówstede Brookton

Rip line at 40mm depth for Sandalwood Plantation, Quandong Plantation and for Salt Tolerate Eucalyptus, Casuarinas and other Eucalyptus, Banksia, Grevillea species.

Gypsum and Basalt Fines where placed at each planting hole as a food source for rock eating microbes and fungi

Remediation of Salt Affected Land; Experience of Karry Fisher-Watts

Treówstede Brookton

Lucerne Fines used as a Nitrogen starter on the Aged Wood Mulch

12th of May 2015 Using Post Hole Digger to dig first lot of Char Wells for each tree to be planted

Remediation of Salt Affected Land; Experience of Karry Fisher-Watts

Treówstede Brookton

Simcoa Biochar activated with Wood Vinegar, Molasses, KNF Fish Amino Acid Recipe, Oriental Herbal Nutrient Recipe, LAB Recipe, IMO 2, EM 1 ™, Phion's Soil Catalyst @ www.phion.com.au

Added to Charwell and Sandal wood Planted

This is an example of a tree that is surrounded by Salt Crystals, it is protected to some degree by the Char Wells which we have drilled to a depth of 30cm by width of 15cm on top of the char wells is Lucerne fines. We filled these up prior to the completely of Summer with Molasses Water, Wood Vinegar only.

Due to size of plants we only used 1 kg of Molasses to 10 kilos of water and 100 mils of Wood Vinegar. Each Tree was given approximately 200 mils of Wood Vinegar Tonic Solution with a litre of Water follow up the following day. All 3000 Char Wells were given this treatment on the 30th of November. This was their last access to water for the entire duration of the Summer Dry.

Remediation of Salt Affected Land; Experience of Karry Fisher-Watts

Treówstede Brookton

Simcoa Biochar activated with Wood Vinegar, Molasses, KNF Fish Amino Acid Recipe, Oriental Herbal Nutrient Recipe, LAB Recipe, IMO 2, EM 1 ™, Phion's Soil Catalyst @ www.phion.com.au
Added to Charwell and Sandal wood Planted

The Bio char on the surface of all the rows and the wood mulch has now sunk into the rip lines with a little on the surface.

Remediation of Salt Affected Land

Biochar 300kg + 250Kg Wheat straw Vinegar Diluted 5:1
Ratio of biochar to Compost 1:3. Applied at 12t/ha
Basal fertilizers of urea, calcium super-phosphate and potassium chloride was applied at 112.5 kg N ha−1, 112.5 kg P_2O_5 ha−1and 112.5 kg K_2O ha−1, respectively.

Lashari et al 2013 Biochar and Salt-stressed soil . Field Crops Research,114, 113–118

Table 1 Basic properties of the topsoil (0-20cm), biochar and pyroligneous solution and biochar poultry manure compost before used for the experiment

Sample	pH (H_2O)	TOC ($g\ kg^{-1}$)	Total N ($g\ kg^{-1}$)	Salt ($g\ kg^{-1}$)	CEC ($cmol\ kg^{-1}$)	Bulk density ($g\ cm^{-3}$)
Top Soil	8.25	5.13	0.70	12.68	21.26	1.33
Biochar	10.35	4.67.20	5.90	41.97	21.70	0.65
PS	9.37	3.87	0.55	ND	ND	ND
BPC	7.50	419.7	25.03	ND	ND	1.00

TOC total organic carbon; CEC cation exchange capacity, ND not detected

Table 2 Salinity of topsoil (0-20 cm) under BPC-PS treatment of the salt-stressed soil

Crop year	Treatment	pH (H_2O)	Salt ($g\ kg^{-1}$)	Na^+ ($g\ kg^{-1}$)
2010-2011	CK0	8.23±0.06a	9.21±0.39a	5.62±0.22a
	BPC	7.94±0.02b	5.63±0.55b	3.69±0.04b
2011-2012	CK1	7.83±0.13ab	8.46±0.41a	5.53±0.13a
	BPC-1	8.00±0.13a	5.57±0.18b	3.66±0.06b
	BPC-2	7.69±0.05b	5.04±0.17b	3.39±0.06c

Different letters in a same column indicate significant differences ($p<0.05$) between the treatments in a single year.

Results of Biochar Affected Land

Table 4 Wheat grain yield under treatments of the salt stressed soil

Rotation year	Treatment	Grain yield (t ha^{-1})
2010-2011	CK0	0.57±0.01b
	BPC	6.61±1.25a
2011-2012	CK1	3.62±0.57b
	BPC-1	4.94±0.19a
	BPC-2	5.80±0.55a

Different letters in a same column indicate significant differences (p<0.05) between the treatments in a single year.

Large Increase In Microbial Population

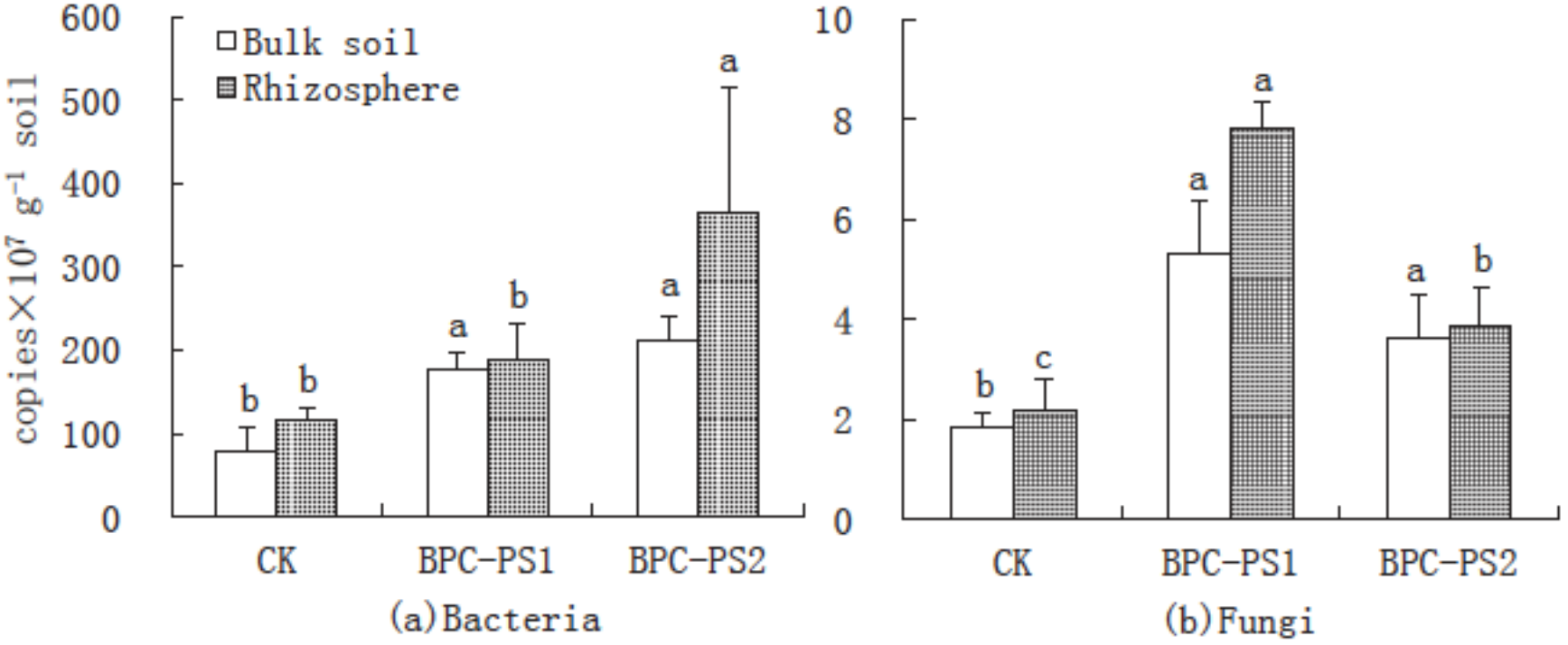
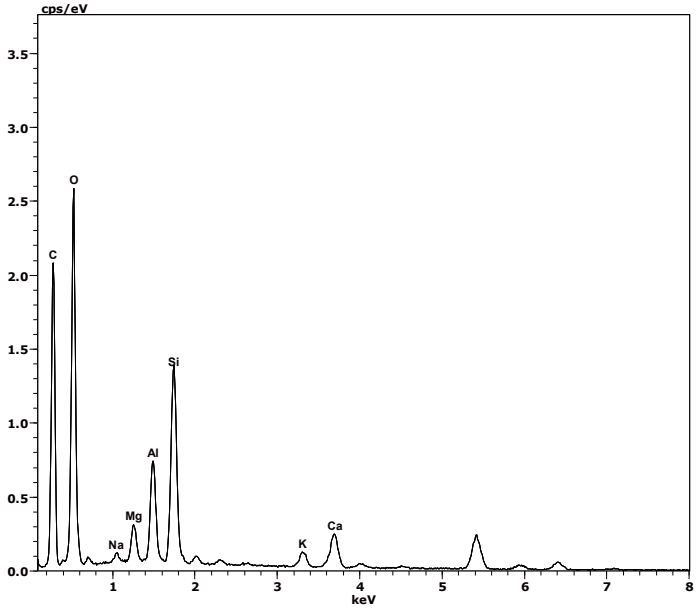
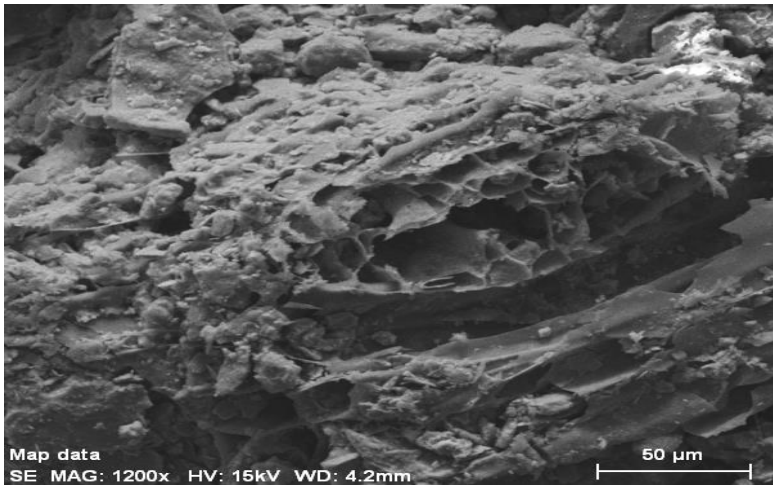
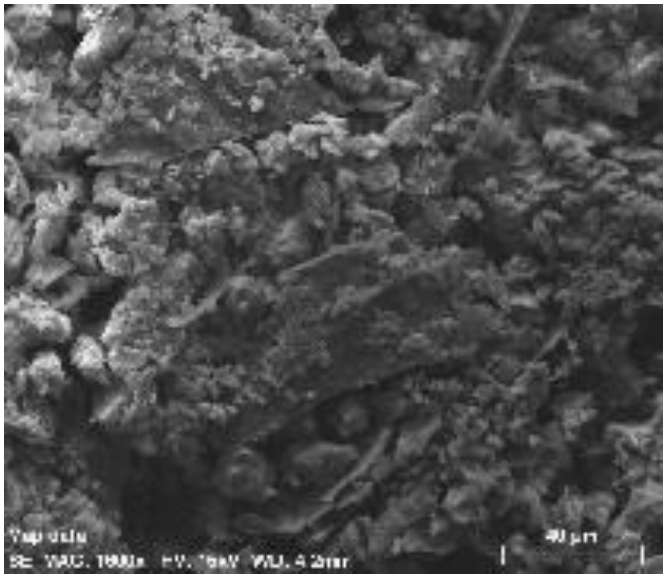


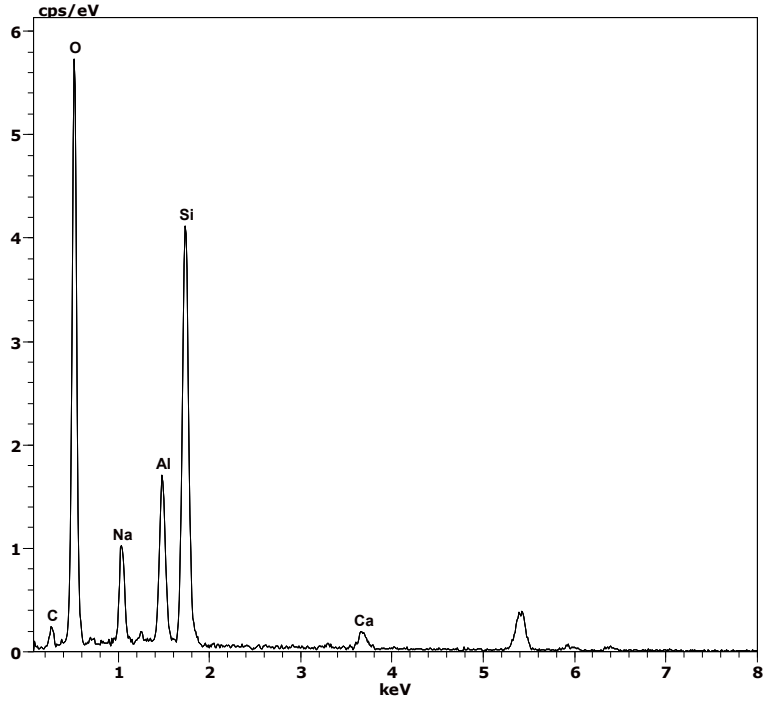
Fig.1

Biochar Adsorbs the Salt and Builds Up Organo-mineral Layers

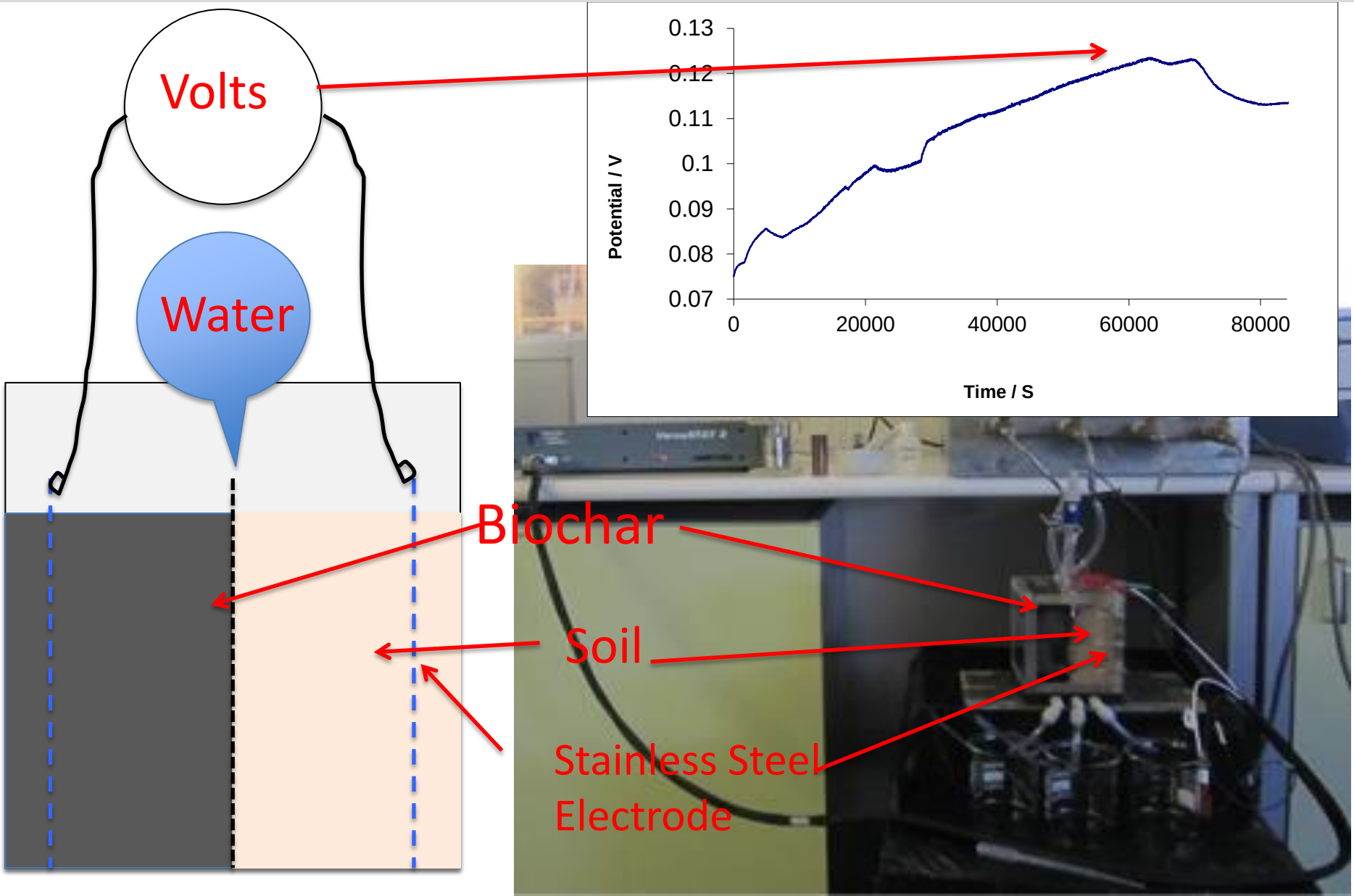




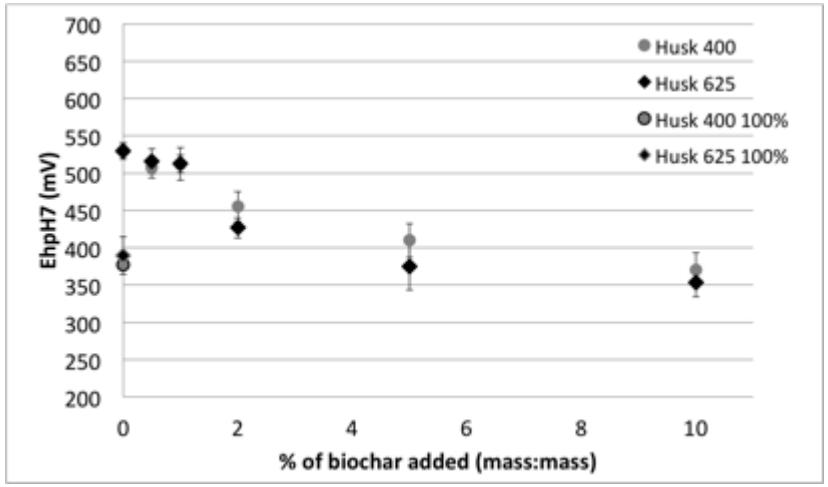


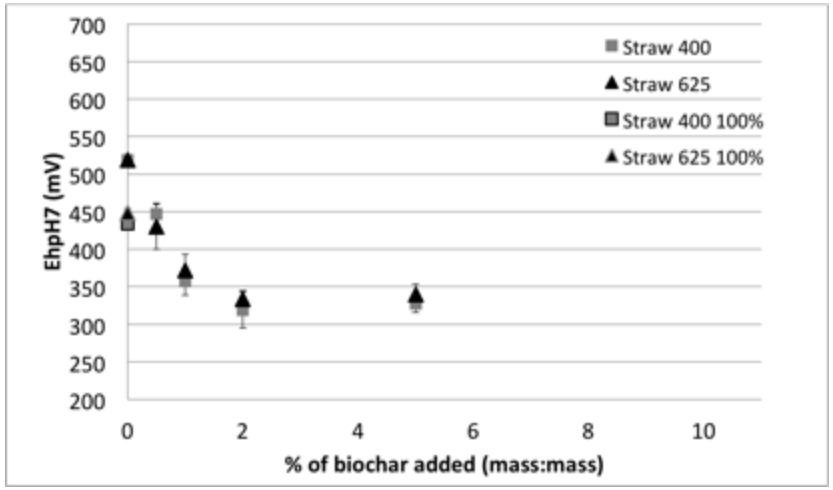


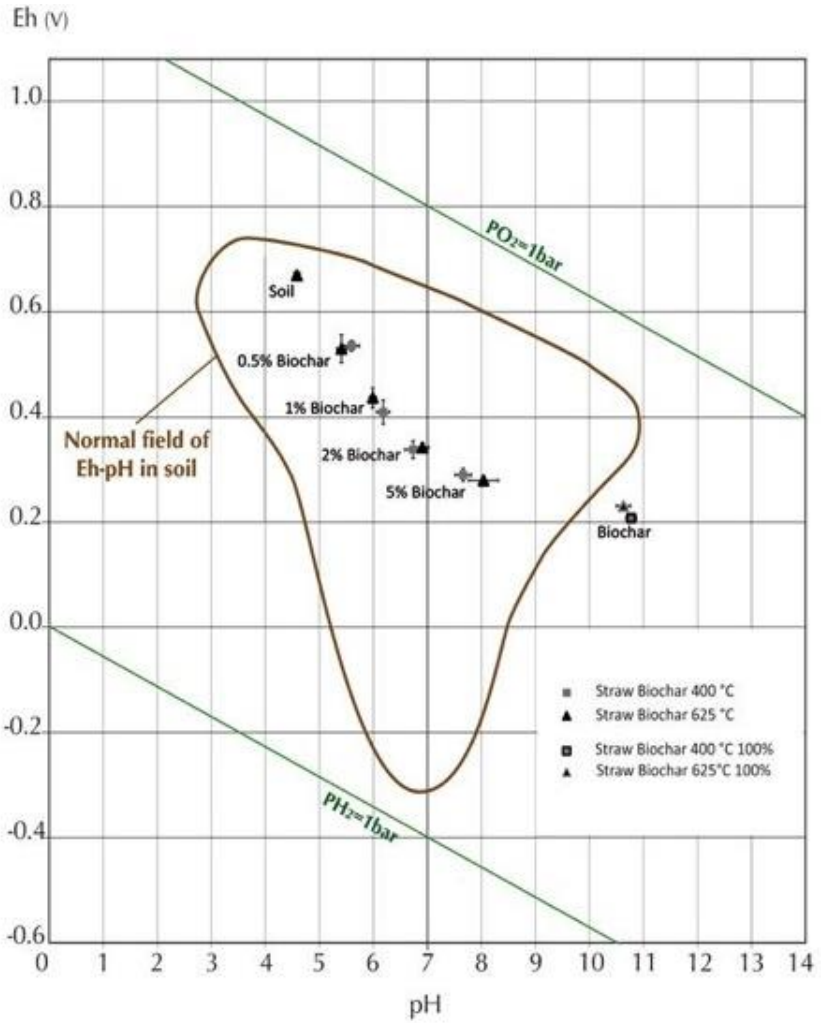
There is a Potential Difference Between the Soil and The Biochar. This Changes Over Time



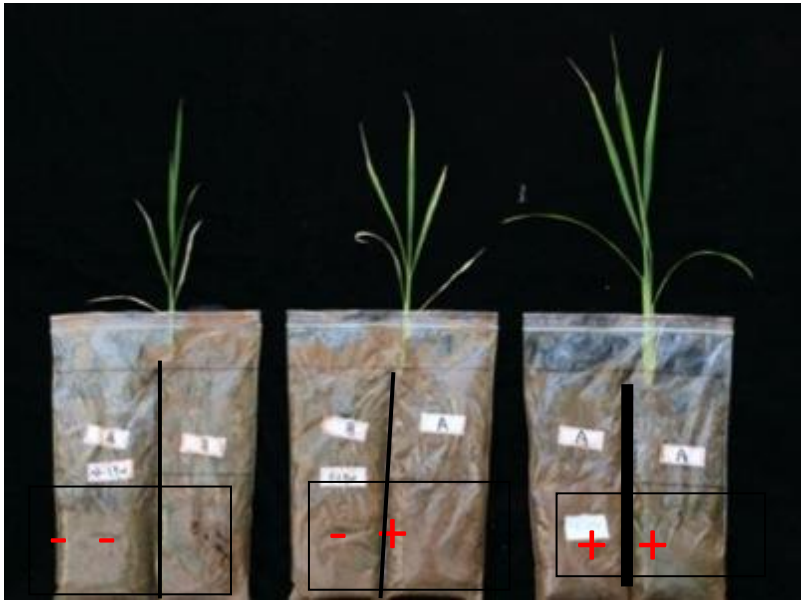
Eh (Redox Potential) is Function of Feedstock and Temperature Soil Type and Application Rate

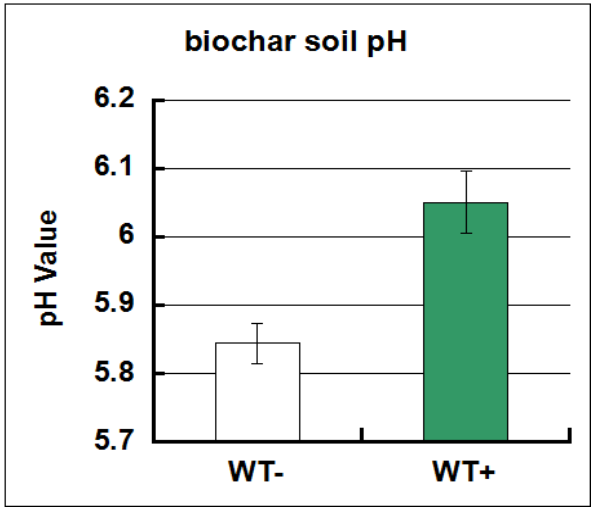


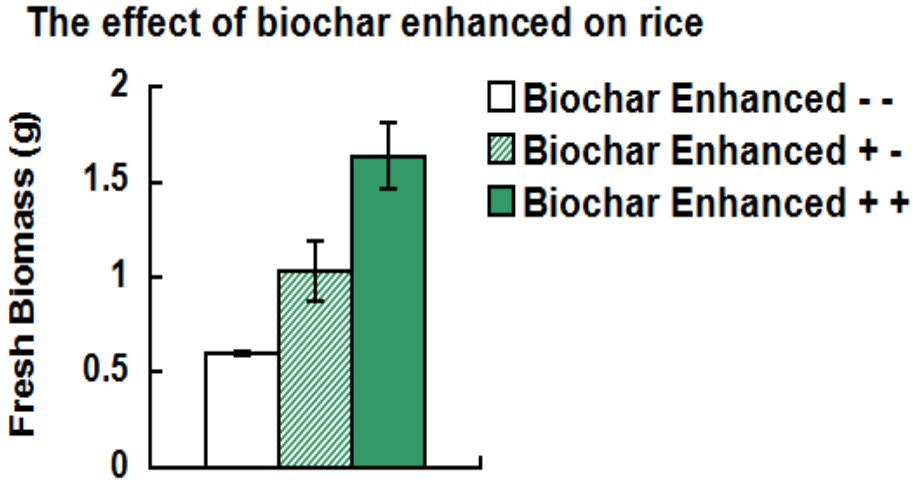




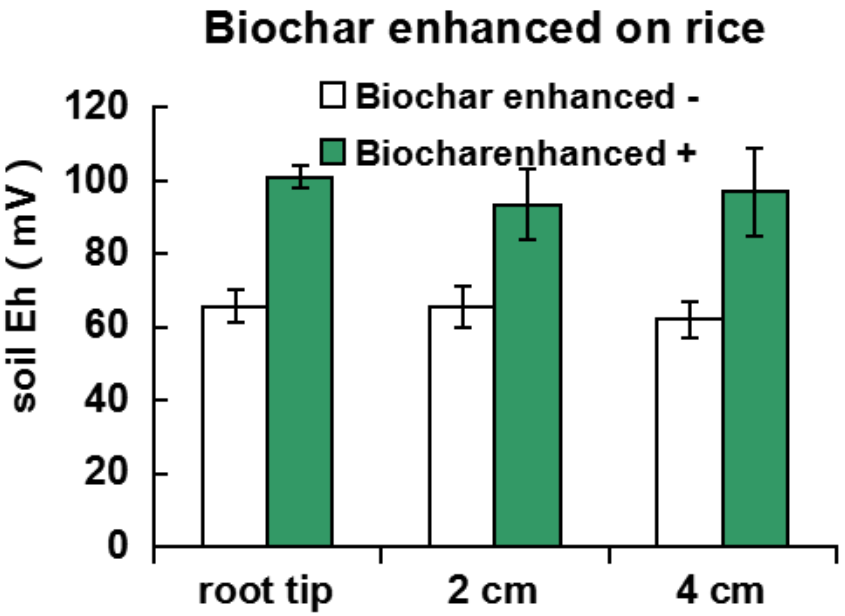
Rice Plant Root Divided Into 2 Parts; Three Treatments No Biochar; Full Biochar; Biochar one side; Measure pH and Eh of Soil and Between inside and Outside of the Cell Wall Membrane
Soil From Rice Paddy and Fully Water Saturated

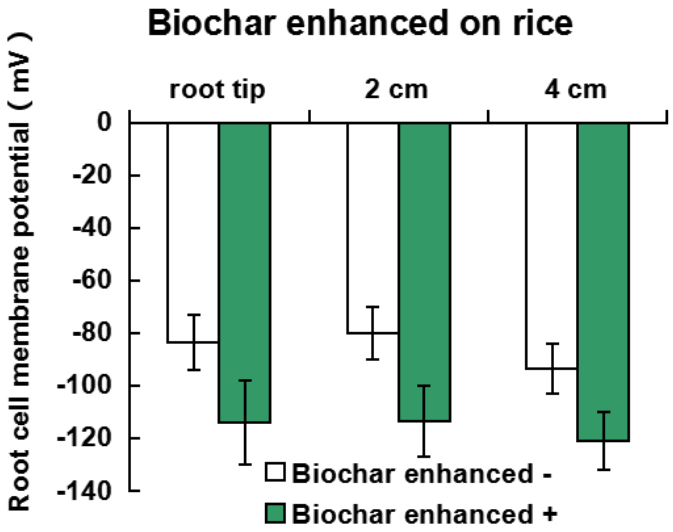


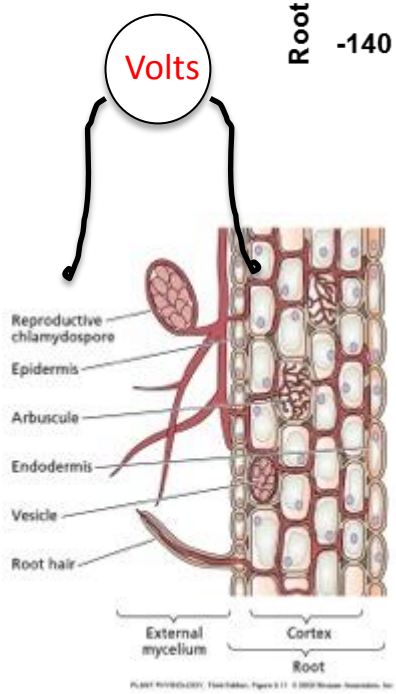




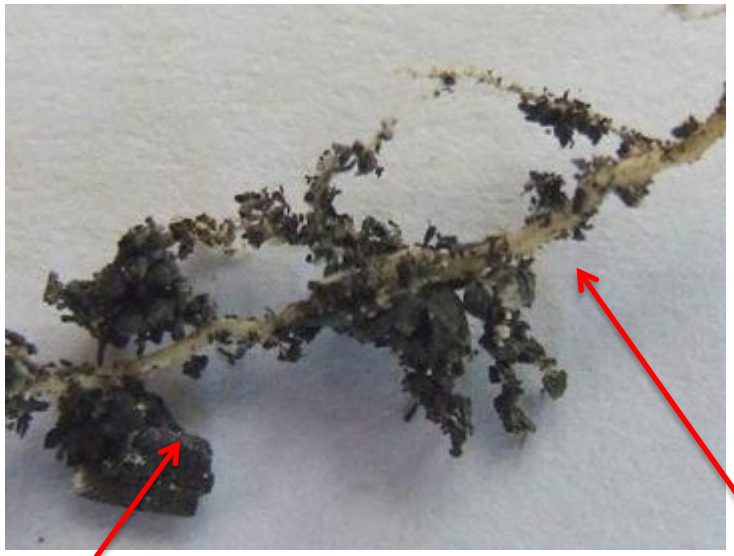
Biochar Increases Soil Eh and and Increases the Negative Potential Potential Across the Root Wall Thus Reducing Energy Required to Uptake Nutrients





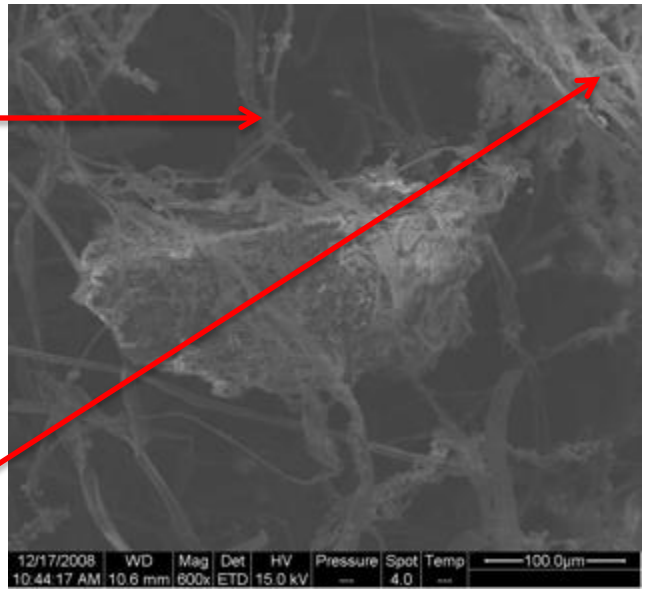


Micro-Organisms and Roots Interact with the Biochar

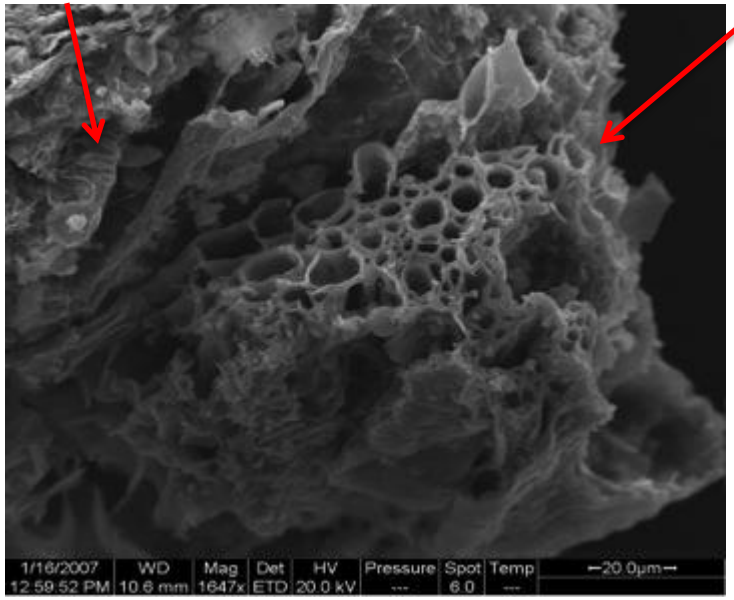


Chicken Manure Biochar

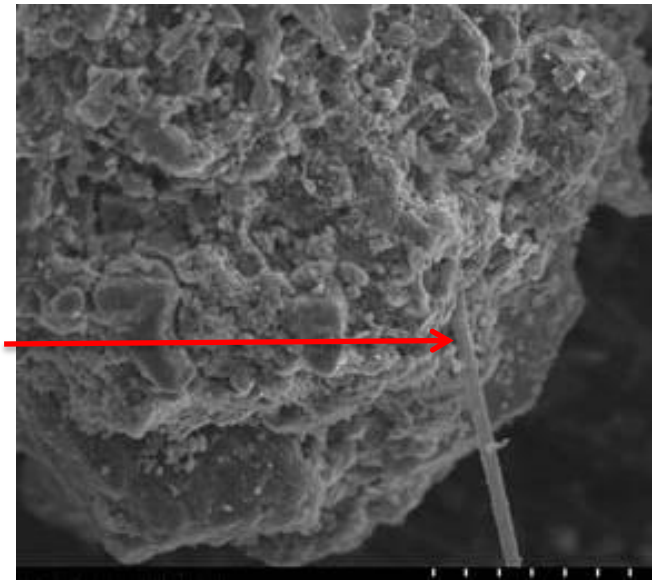
Fungi



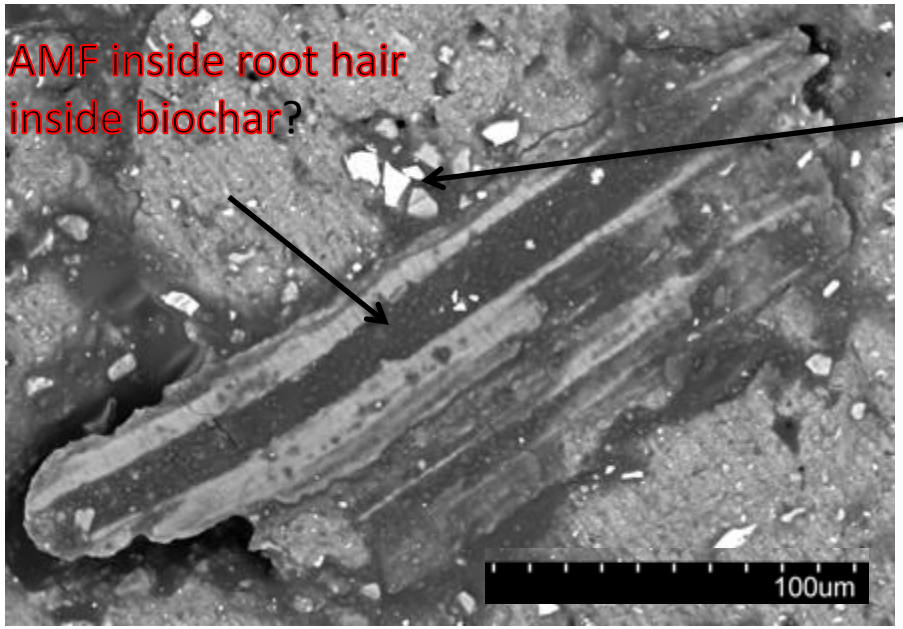
Root

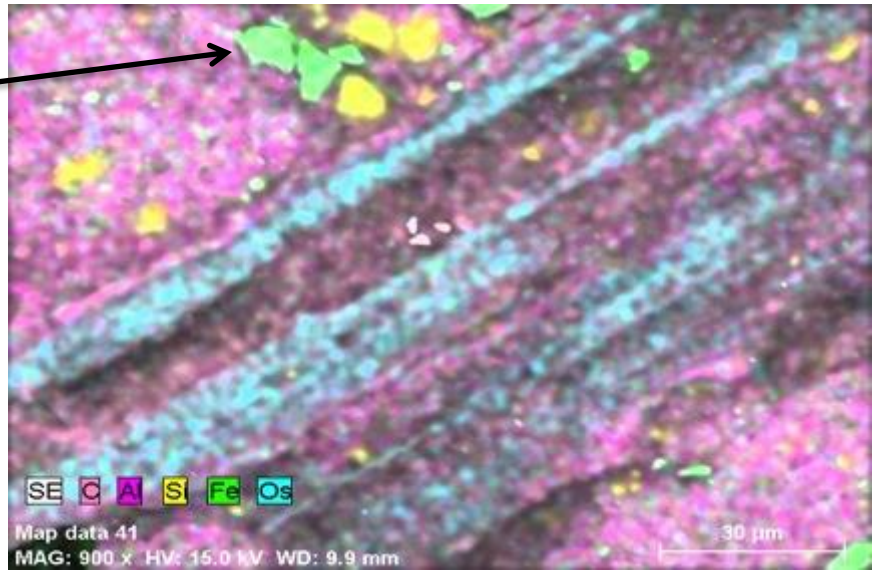


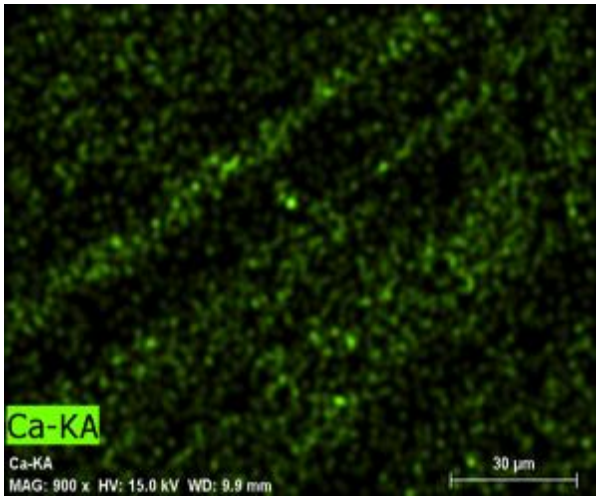
Root Hair

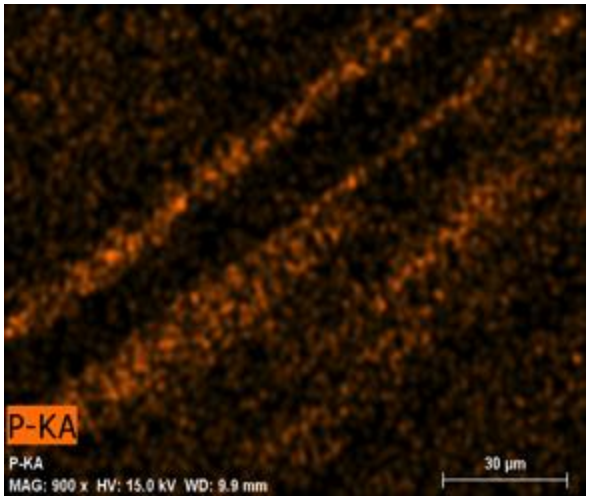


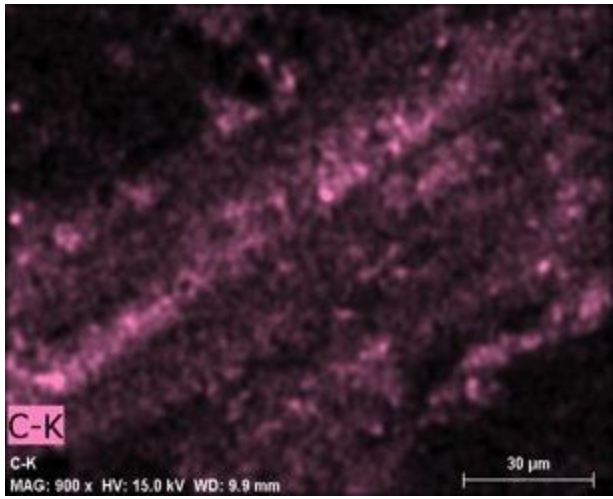
Interaction of Biochars Microbes with Root Hairs



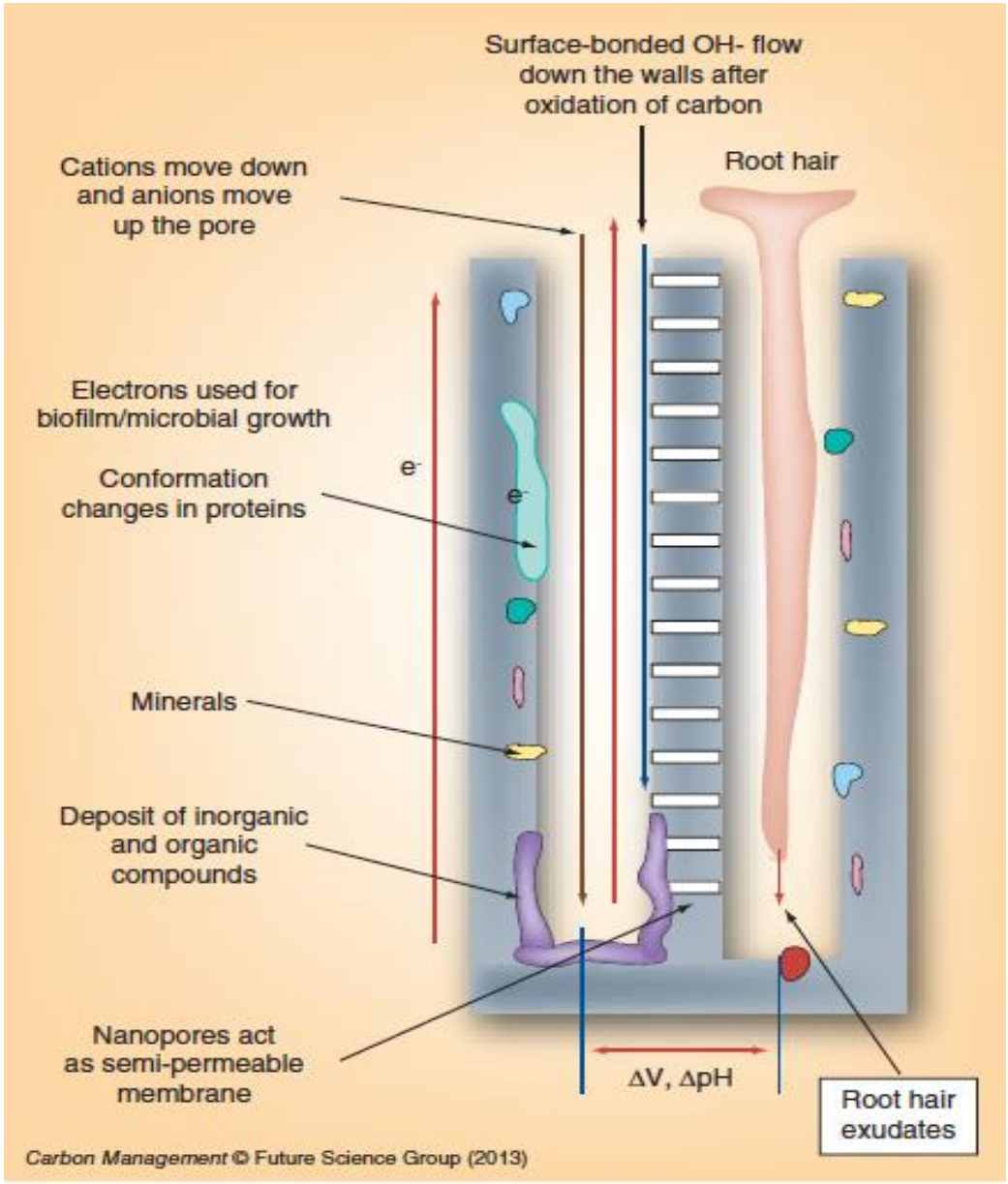








Complex Reactions in Pores; Allows Plant to Resist Stress



In Urban Buildings and Restaurants; Joost Bakker