



## Effects of Flashed Carbonized<sup>©</sup> Macadamia Nutshell Charcoal on Plant Growth and Soil Chemical Properties

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## Terra Preta (Amazonian Dark Earths): Highly Fertile Anthropogenic Soils



Picture source: <http://www.gerhardbechtold.com/TP/gbtp.php>



Photo source: University of Bayreuth

Terra Preta Soil



Photo source: University of Bayreuth

Typical Upland Amazonian Soil

## Effect of Charcoal on Plant Growth



Photo source: <http://tinselwing.wordpress.com/tag/terra-preta/>

Charcoal Additions

No Charcoal Additions



## Objective:

To demonstrate the effectiveness of charcoal additions on plant growth in two Hawaiian soils

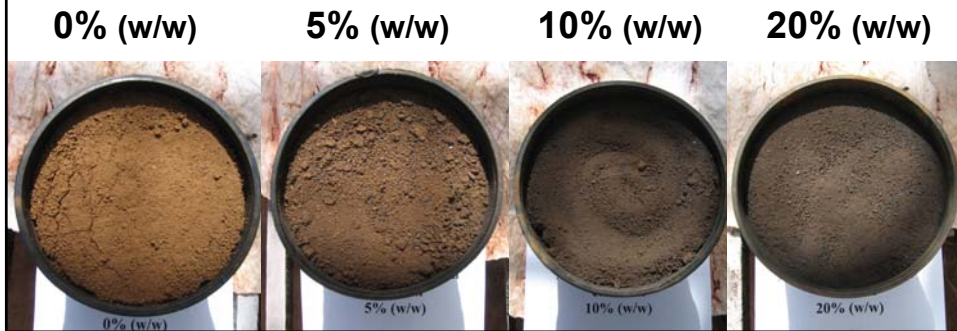


Flash  
Carbonized<sup>®</sup>  
Charcoal

Hawaii Natural  
Energy Institute

## Materials and Methods

- Cultivated fertile, volcanic ash soil (Waimea Series)
- Flash Carbonized © macadamia nutshell charcoal
- Lettuce
- 4 treatments, 3 replicates



## Results

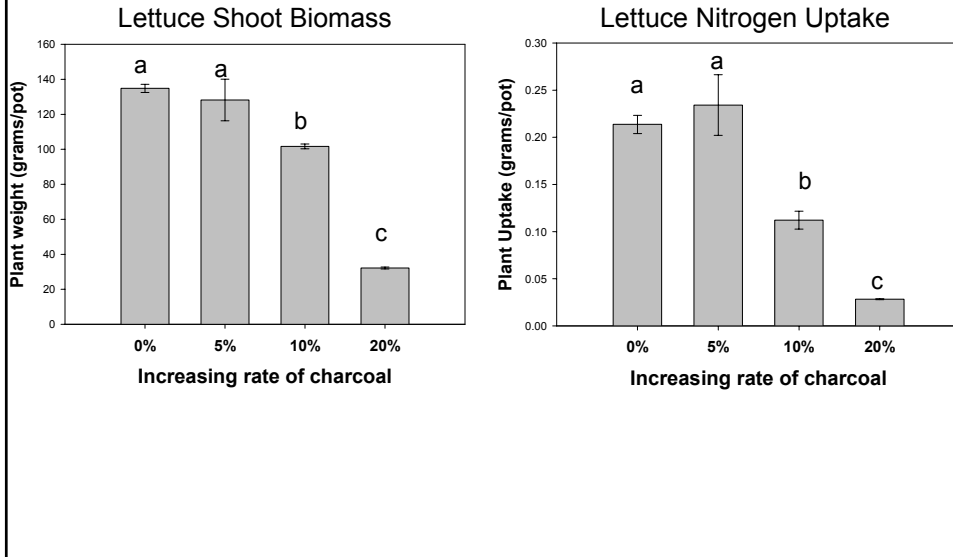


- With no charcoal additions

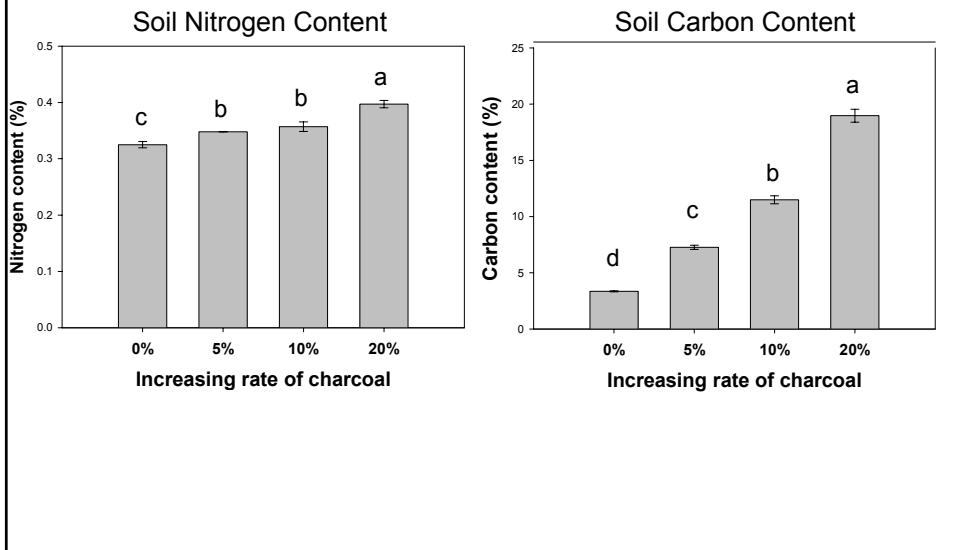


- With 20% (w/w) charcoal addition

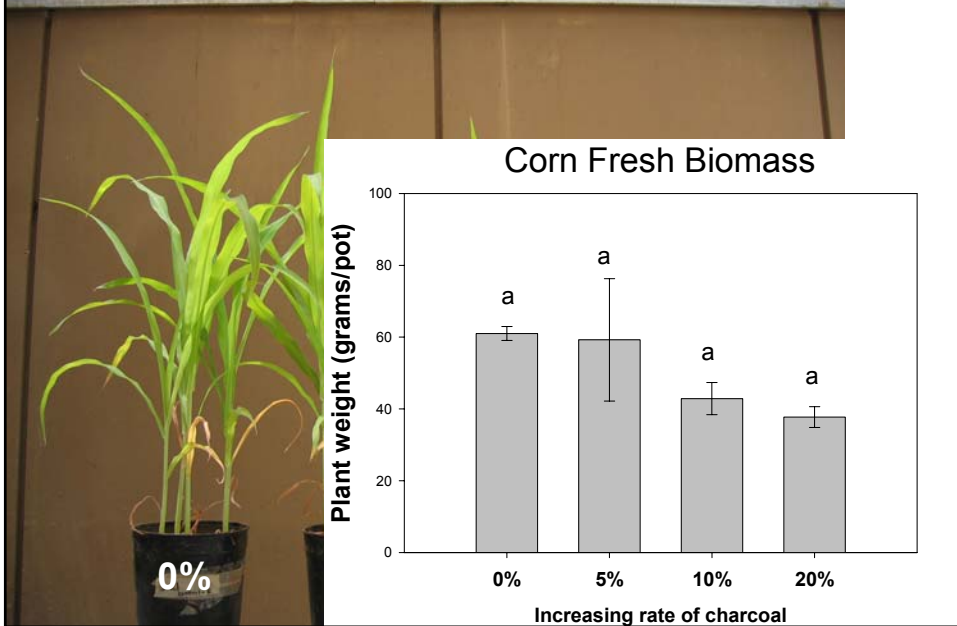
# Plant Effects



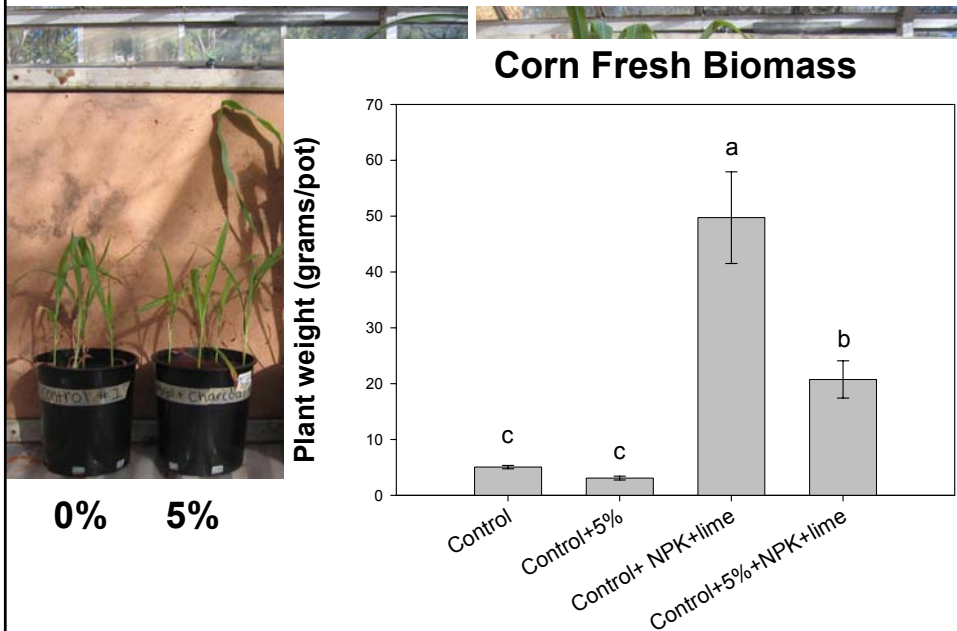
# Soil Effects



# Corn Experiment



# Charcoal Effect in an Infertile Soil



## Preliminary Conclusion:

Charcoal used in the experiment caused a negative effect on plant growth

But why?

- Crop?
- Soil??
- Charcoal???

• **Volatile Matter (VM) content**: a measure of the susceptibility of charcoal to further decompose and form carbon when heated

### **Charcoal Behavior Upon Wetting**

Water Repellency



22.5% VM Content

Water Absorption



6.3% VM Content

## Hypothesis:

**The volatile matter content of charcoal affects its value as a soil amendment**

Uneven Infiltration



Soil with High VM Charcoal

Uniform Infiltration



Soil with Low VM Charcoal

## Materials and Methods

- More degraded tropical soil (Leilehua Series)
- High (22.5%) and low (6.3%) volatile matter content charcoal
- Corn
- 5 treatments, 3 replicates
  - control
  - control + 10% (w/w) high volatile matter charcoal
  - control + 10% (w/w) low volatile matter charcoal
  - control + lime + NPK
  - control + 10% (w/w) low volatile matter charcoal + lime + NPK



**0% (w/w)**



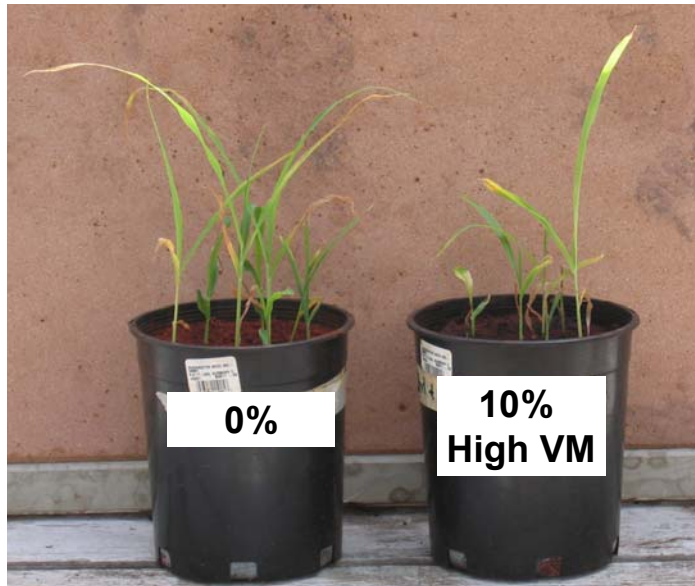
**10% High VM**



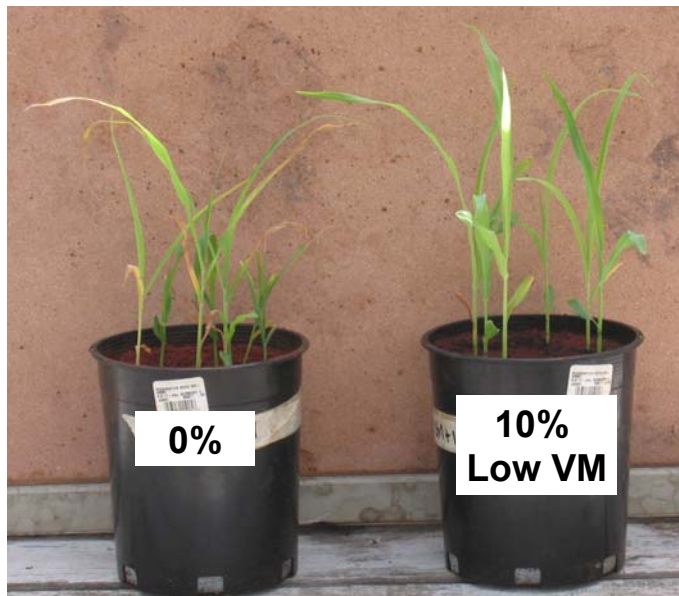
**10% Low VM**



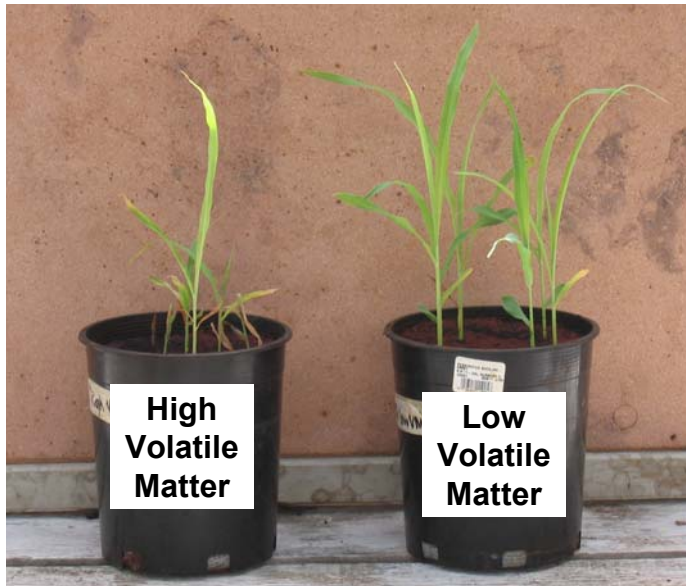
## Effect of High Volatile Matter (22.5%) Charcoal on Plant Growth



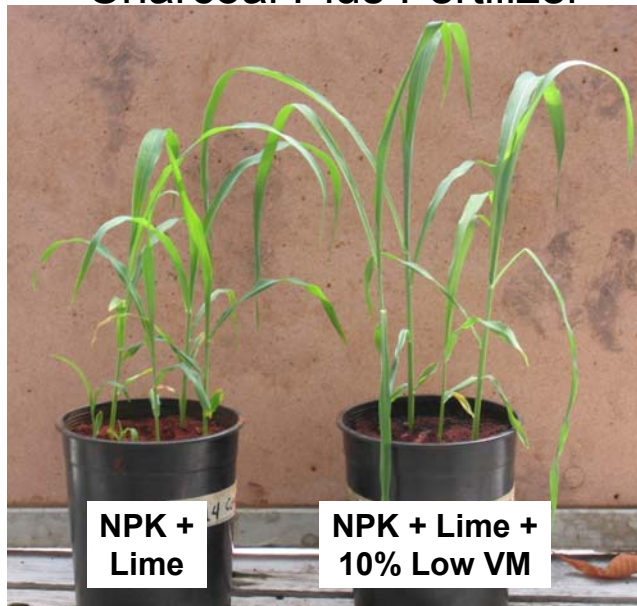
## Effect of Low Volatile Matter (6.3%) Charcoal on Plant Growth

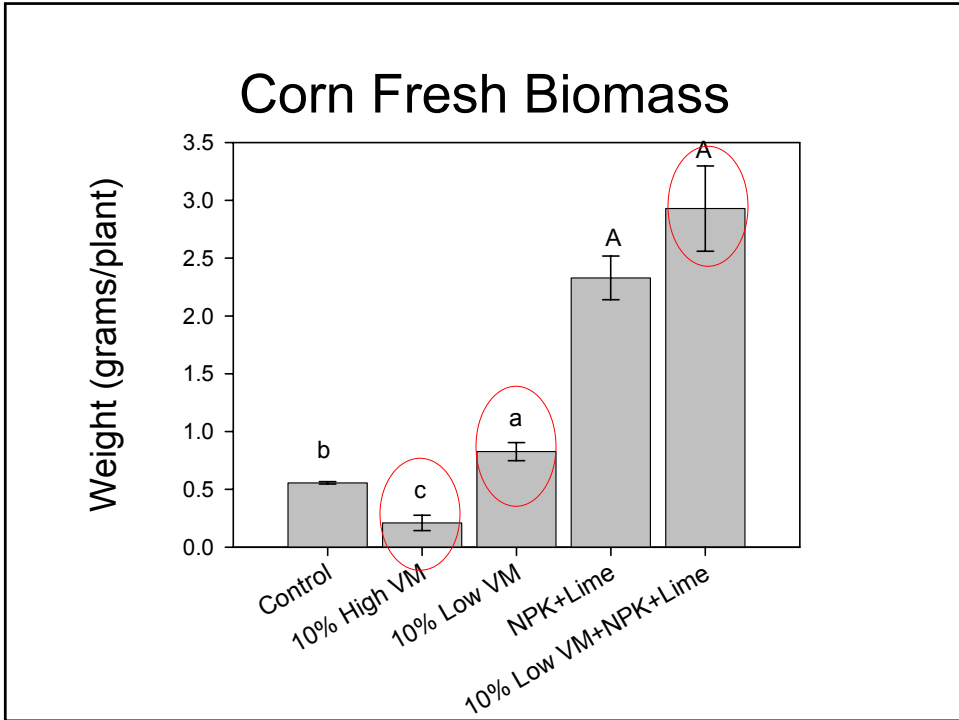


Low Volatile Matter Charcoal (6.3%) versus  
High Volatile Matter Charcoal (22.5%)



Combined Effect of Low Volatile Matter  
Charcoal Plus Fertilizer





### Conclusions

High volatile matter content charcoal has a detrimental effect on plant growth

**BUT!**

Low volatile matter charcoal may have a beneficial effect on plant growth, especially when combined with fertilizer

**What type of charcoal are you adding to your soil?**



Volatile Matter: 36.4%

OR



Volatile Matter: < 4.5%

## Acknowledgments

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