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Preliminary study of Biochar application in subarctic soils

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Introduction

Alaska is in a region where productivity is limited by the cold climate, short growing season, and young nutrient-limited soils. These factors contribute to heavy dependence on synthetic fertilizers. However, with the rising cost of fossil fuels, and the absence of fertilizer producers in the state, commercial soil additives can quickly become cost prohibitive. Biochar has the potential to benefit both producers and consumers by lowering production costs, and increasing food quality, while simultaneously answering food security issues.

This research is focused on nutrient retention in soils after biochar applications in two consecutive years. Data analyzed will demonstrate if the use of biochar as a soil amendment in Alaska is a viable practice for farmers in the state.

Biochar will be attained using a simple pyrolisys/gasification system created in a 208 liter steel drum using biomass from black spruce (*Picea marianna*). Once the biochar has been created, its physical and chemical properties (available nutrients) will be analyzed using a scanning electron microscope (SEM) and extracted by Mehlich III double acid method then measured by ICP- mass spectroscope respectively.

Barley (*Hordeum vulgare*) will be grown under four replicates of each of four treatments, including 1) control (no soil additive), 2) commercial fertilizer 3) biochar addition 4) biochar and fertilizer. Soil samples will be collected every two weeks during the growing season and analyzed for pH (water 1:1), electrical conductivity (saturated paste), N, P, K and micronutrients (Mehlich III), exchangeable bases and cation exchange capacity (extracted by NH_4 Ac then stem distillation), total carbon and nitrogen (LICO CNS analyzer). According to laboratory methods Michaelson et al (1997). The statistical analysis will be analyzed using ANOVA.

Results and Discussion

The soil type used for biochar is a Bohica silt loam, classified as Coarse-loamy, mixed, superactive, Typic Haplocryepts according to Soil Taxonomy (Soil Survey Staff 2010) and Fluvic Cambisols according to WRB (IUSS Working Group WRB 2006). The parent material is loess over alluvium or fluvial deposits reworked by wind (NRCS 2008).

It is expected that biochar application will enhance soil nutrient holding capacity and increase crop yields. Biochar may improve soil structure by increasing organic matter content while retaining water and nutrients.

Table 1. Typical soil profile and chemical soil characteristics

Horizon	Depth cm	Texture	CEC cmol/kg	pH
Oi	0 to 5	Slightly decomposed plant material	peat	5.0-5.6
A	5 to 10	Silt loam	20 - 30	5.1-7.3
Bw	10 to 45	Silt loam	15 - 25	5.6-7.3
C	45 to 182	Stratified very fine sand to loamy fine sand	10 - 25	5.6-7.3

Conclusions

Biochar has been used in small and large scale operations around the globe. Australia, Kenya, India, Brazil, Colombia and other countries have adopted biochar as a soil enhancer using different type of biomass successfully. (www.IBI.org). Since soils in Alaska are weakly developed, this project will promote the use of a sustainable economical practice that is environmentally sound. The emerging biochar production technology promises the possibility of local, state, and regional benefits.

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