

Biochar as soil fertility amendment for crop production in Poland and Wyoming

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Project Duration: 12 months

Funds were requested to cover the costs associated with PI's 1-week travel to Wroclaw, Poland and to host Polish scientist at the University of Wyoming for a period of two weeks. Dr. Medynska-Juraszek is an internationally recognized researcher in the field of biochar (<http://www.biochar.po.opole.pl/agnieszka-medynska-juraszek/>) with the main focus on the use of biochar for soil fertility and soil health improvement in agricultural crop production and land reclamation. The main goal of this exchange is for PI Norton to learn new methodologies associated with assessment of biochar and to host Collaborator Medynska-Juraszek at the University of Wyoming. The first trip took place in July 2015. PI Norton travelled to Wroclaw where she spent some time touring the university and the town of Wroclaw, participated in a number of meetings with researchers and travelled to research sites to deploy the project. The main objectives of the proposed project and corresponding accomplishments and new knowledge are explained below:

Objective 1: *To assess the effectiveness of biochar and learn methodologies and techniques used in greenhouse research and on-farm experiments in Poland (led by A. Medynska-Juraszek);*

There are three main experiments deployed. The first experiment monitors the long-term effects of biochar on yield of tomatoes and cucumbers in greenhouse production. This experiment was in the second year of the three year cycle. Preliminary results and observations showed notable differences in yield and soil mineral N content at medium to high biochar rate when compared with the control. Differences were also observed between biochar amended treatments and a treatment that contained commercial fertilizers at a nutrient rate comparable with the level applied to biochar. Soils amended with biochar demonstrated improved water holding capacity suggesting more efficient water use. Consequently, the amount of irrigation water was slated to be cut by 30-50% in the following year.

The second experiment was established to monitor the effects of biochar on crop yield and soil fertility of corn and canola. The experiment was established in the spring of this year. The biochar material used in this study, though certified as high quality soil amendment suitable for crop production appeared to have physical properties that evoked plant nutrient deficiencies when applied at the highest rate. It was concluded that the biochar has not undergone a proper process of heat-induced pyrolysis resulting in reduced quality and negative influence on crop yields.

The third research project was to monitor the effects of biochar to immobilize heavy metals during the process of post-mining land reclamation under laboratory conditions. This project was in its inception and the results have not been available yet as the process of laboratory analyzes was scheduled to happen in winter 2015/2016.

Objective 2: *To assess the effect of biochar as an amendment for horticultural substrates and agricultural soils on GHG emissions (led by U. Norton);*

The monitoring was established in the second experiment that studies the effect of biochar amendment on corn and canola yield and soil properties. The equipment was deployed in the field and the sampling collected. At the time of report writing the samples have not been analyzed yet. As mentioned earlier, the main concern was the quality of the biochar applied in this study and the PI and Collaborator decided to design a follow up laboratory study to determine the efficacy of use of different kinds of biochar on extended nutrient bioavailability and GHG emissions. This experiment is scheduled to be deployed during fall 2016 and will be led by PI Norton.

Corresponding objectives also included:

- *Assessment of research tools developed to evaluate agroecosystem sustainability and alternative practices used in European Union;*
- *Feasibility of application of newly learned tools in research and instruction at the University of Wyoming;*
- *Informing academic communities at universities in Wroclaw and Laramie with relevant research conducted at both institutions through a series of interactive meetings and seminars;*

A series of formal meetings and individual discussions took place during PI's visit to Wroclaw. PI met with Prof. Jerzy Weber (Department Head), Profs. Karczewska, Kabala, Bogacz, Jamroz, Kocowicz and others. The analytical equipment available at the University of Wroclaw and other universities in Poland and methodologies developed to study biochar provide great capacity to generate high quality research. They are also compatible with the equipment PI uses at the University of Wyoming. Examples include methods to study very complex forms of soil organic matter that while combined with the measurements carried out by PI at UW can provide a better understanding of SOM changes in soil.

While at UW, Collaborator Medynska-Juraszek met with Dr. Bret Hess (Dean), Dr. Jim Heitholt (Plant Sciences Department Head), numerous College of Ag faculty members, visited analytical labs at the Department of Geology and the Isotope Lab on campus. She also toured the campus and participated in field sampling at the SAREC research station. At the end of her visit, Dr. Medynska-Juraszek delivered campus-wide announced research seminar.

Long-term goals: This project helped establish meaningful cooperation between University of Wyoming College of Agriculture and Natural Resources and Wroclaw University of Natural Sciences. It helped launch international dialog and collaboration that would strengthen international research priorities in program in Agroecology. Specifically this project allowed to: (1) engage the two institutions in an effort to compile research recommendations for sustainable farming; (2) facilitated technology transfer and exchange; (3) designed best assessment methodologies for comparative research, outreach and extension efforts and (4) solicited ideas for future collaborative research, joint pursuit in grant writing and fund solicitation.



Winter wheat field in south western Poland



Field experiment (control plots)



Low rate of biochar



High rate of biochar



GHG monitoring



Dr. Medynska-Juraszek during GHG sampling