Abstract ID: 1239

Combining Coal Fly Ash and Poultry Litter Amendments for Enhancing Biofuel Feedstock Production by Indiangrass

Kankarla V.*, E. Adeleke, O. Ogunmayowa and E. Kudjo Dzantor

Department of Agricultural and Environmental Sciences, Tennessee State University, Nashville, TN 37209, USA.

ABSTRACT

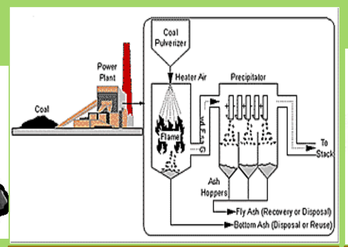
Waste to energy conversions are emerging as one of the creative strategies with the current focus on energy security and environmental sustainability. With the increasing attention on bioenergy crops on one hand and the problems associated with the higher costs of effective management of coal fly ash (CFA) on the other, the emphasis on utilization of CFA as a soil ameliorant has been receiving a great deal of attention in the recent times. In this context, my research intends to identify the optimum levels of CFA amendments to the soil that could enhance simultaneously the utilization of CFA and biofuel feedstock production.

INTRODUCTION

Coal is a major resource for generating electricity worldwide. Burning of coal not only produces electricity but also coal combustion products (CCPs).

In U.S alone 110 million tons of CCPs are produced annually during generation of 4 trillion kilowatts hours of electricity.

Coal



Generation of electricity and CFA as residue

Coal fly ash

CCPs contain significant amounts of toxic substances that can pollute land, sediments, air and ecosystem health and hence require effective disposal. Currently, CFA disposal methods are limited to environmentally undesirable options of either storage in large, wet impoundments or landfills.
CFA also has excellent physical and chemical characteristics such as good water retention and storage and supplies all major and trace elements to the crops.

The increasing costs of CFA management/disposal methods and its favorable properties, has prompted growing advocacy for its beneficial utilization in agriculture.

With the present focus on bioenergy crops in U.S, the use of CFA as soil amendment in warm season perennial grasses (WSPGs)is an appealing proposition; this significantly reduces the CFA that needs to be disposed of while enhancing the biofuel feedstock production.

This experiment is a preliminary investigation on the potential of enhancing biomass productivity by the WSPGs namely, Indiangrass (IG) through soil amendment with combination of CFA and poultry litter (PL).

GOAL AND OBJECTIVE

GOAL: Our goal is to combine by-products from fossil fuel production and organic wastes for simultaneous environmental remediation and enhance biofuel feedstock production.

OBJECTIVE: Combine phytoremediation by WSPGs, namely IG and switchgrass (IG), to clean up CFA accumulations and simultaneous enhancement of biofuel feedstock production under neutral and acidic soils.

MATERIALS AND METHODS

- **SOIL:** Armour silt loam (fine-silty, mixed, thermic Ultic Hapludalfs) from Tennessee State University Research and Education Station, Nashville, TN.
- **PLANTS (WSPGs):** '*Osage*' Indian grass (IG) and '*Alamo*' switchgrass (SG) purchased from Star Seed Inc., Osborn, KS, for this project.
- **COAL FLY ASH:** From Tennessee Valley Authority Kingston Plant (Carriker and Rogers, pers).
- **POULTRY LITTER:** Pelletized PL from Natural Organic Warehouse (NOW), Andover, Kansas.
- **SOIL PREPARATION AND AMENDMENT:** Soils were sieved through 2 mm sieve and were adjusted to experimental pH levels (4.5 and 6.5) using $Al_2(SO_4)_3.18\ H_2O$ or $CaCO_3$ following modifications described by Dzantor *et. al*., Appropriate amounts of CFA were added to separate portions of pH-adjusted soils to provide 5 % CFA(w/w) amendment.
- **PLANTING:** Seeds of each plant were sown in germination trays containing potting mix till they reached 3- to 4 leaf stage where they were planted into 5 inch pots with appropriately pH adjusted soils.
- **EXPERIMENTAL DESIGN:** The Treatments are as follows:
  (2 WSPs (IG and SG) x 2 pH (4.5, 6.5) x 2 FA Amendments (UA%, 5%) x 2 PL (0, PL))

where, WSPGs = Warm Season Perennials Grasses (IG, SG); CFA = UA (unamended), 5% amendment (w/w); PL = Poultry litter {0 (none), PL (75 mg/kg N)}; Design: Completely Randomized Design; Total Treatments: 16; No. of Replications: 4 each; Total pots: 64

- **HARVESTING AND BIOMASS DETERMINATIONS :** After three months of plant growth, the above ground (shoot) biomass and the below ground (root) biomass was determined by cutting shoot tops and roots to heights of 15 cm respectively. Harvested biomass from each replicate was bagged separately and dried at 70^0C to constant weight (3-5 days). Care was taken to wash the roots under stream of water to remove the soil.
- **DATA ANALYSIS:** Biomass data was analyzed by taking root and shoot biomass averages, standard deviations and Root to Shoot biomass ratio.

RESULTS AND CONCLUSIONS

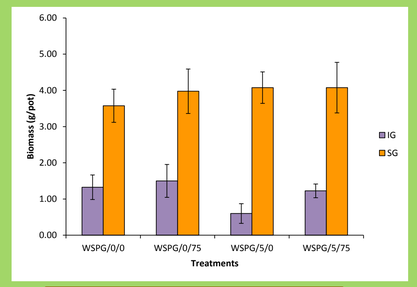


Fig 1. Shoot Biomass at pH 4.5

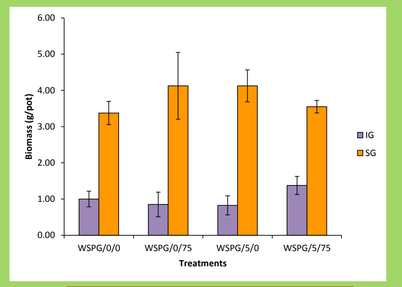


Fig 2. Shoot Biomass at pH 6.5

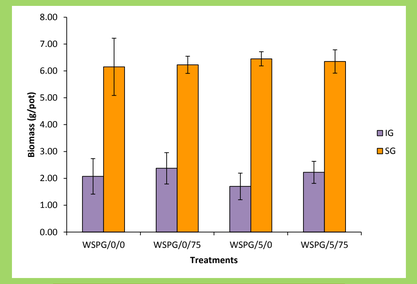


Fig 3. Root Biomass at pH 4.5

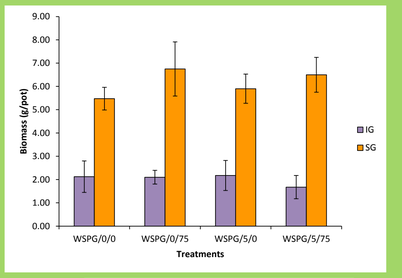


Fig 4. Root Biomass at pH 6.5

- Soil amendment with CFA, with or without PL at the specified levels, marginally enhanced biomass productivities by IG
- Soil pH did not appear to influence biomass productivity of IG
- There was low biomass productivity by IG than by SG, which is a model bioenergy crop
- The preliminary results were positive, therefore our ongoing experiments are examining the use of Mycorrhizal and /or vermicompost for enhancing biomass productivity and neutralization of toxic substances in CFA

REFERENCES

- Dzantor, E. K., V. Murugesan, D. Hui and R. Painter. 2011. Biomass productivity potential by selected cellulosic herbaceous perennials in acid impacted soil. Proceedings of SNA Annual Conference 56:404-410. January 18-22, 2011
- http://www.caer.uky.edu/kyasheducation/flyash.shtml (2014). Fly Ash Explored – What Are Coal Combustion By-Products (CCBs) Kentucky Ash Education Site, assessed January 13th, 2014.