Level of Carbon Tax Required for Switchgrass and Miscanthus to Compete with Coal for Generating Electricity

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INTRODUCTION
Coal is the primary fuel used by the nation’s electric power industry. Coal produces 36% of the carbon dioxide emissions from energy use [1]. Cofiring with cellulosic biomass is more efficient in reducing greenhouse gas emissions than when it is used for producing ethanol. Cofiring requires only minor modifications and minimal investments in existing plants [2].

A key decision to ensure a cost-efficient long term supply of biomass feedstock depends on the selection of species and management practices.

Switchgrass (Panicum virgatum) serves as a model dedicated energy crop. Miscanthus (Miscanthus x giganteus) is an alternative.

Biomass is more expensive than coal if the externalities of burning coal are ignored. A tax on CO2 emissions could be used to incentivize cofiring with biomass.

OBJECTIVES
To determine the most economical species and harvest frequency (once or twice per year)
To determine the CO2 tax required for either of the two candidate feedstocks to be an economically viable alternative for cofiring with coal to generate electricity

MATERIALS AND METHODS
Annual dry-matter yield and gross energy data were produced in side-by-side trials conducted in Stillwater Oklahoma.

Fixed effects: Species and harvest levels
Random effects: Replication and year

Separate models were estimated with biomass yield and energy content as dependent variables using the MIXED procedure of SAS.

RESULTS

- Biomass yield differs across species. Annual yield is not enhanced by multiple harvest.
  - Fig 1. Biomass yield

- Switchgrass with a single annual post-senesence harvest produced more biomass than miscanthus.

- Energy production per land unit was greater with switchgrass.

- For the U.S average coal price of $40 per Mg, the value of switchgrass biomass based on energy content is estimated to be $27 per Mg.

- The estimated cost to produce and deliver biomass a distance of 50 km was $44 per Mg for switchgrass and $52 per Mg for miscanthus.

CONCLUSION
- The best strategy for producing biomass in the region would be to establish switchgrass and harvest once a year after senescence.
- Harvesting twice a year is not an economically viable cultural practice in the region for either species.
- The carbon tax based on CO2 emission, required for cofiring switchgrass biomass with coal to breakeven with using only coal is estimated to be $7 per Mg of CO2.
- The production of cellulosic biomass for cofiring is not financially viable without government intervention.

REFERENCES

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