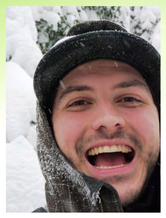
Biochar and poplar cultivation :



Producing bioenergy and reducing emissions of greenhouse gases

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Introduction

The atmospheric concentration of greenhouse gases (GHG), responsible for global warming, has increased significantly in recent decades, particularly influenced by the massive use of fossil fuels and intensive agriculture.

This research project is part of an effort to understand and act against this phenomenon of global warming. It aims to assess the efficiency of new methods for growing hybrid poplar trees for bioenergy that reduce inputs while producing biomass for bioenergy, which could replace fossil fuels.

Objectives

Hybrid poplars are a fast-growing species well adapted to the climate of Quebec. Planted in a short rotation coppice (SRC) , poplars produce a significant biomass for bioenergy[1], and have a low GHG impact.

Combining SRC with biochar properties (See "what is Biochar?" box) could improve and maximize yields while limiting environmental impacts of planting. (GHG emissions, decrease fertilizer amounts)

Hypothesis

1. Incorporating Biochar into the soil improves poplars yields

2. Incorporating Biochar into the soil favors interactions with fertilization (Nitrogen and others nutriments)

Experimental design

2 sites with 48 plots of 50 plants :

Québec city : Clay loam

Montréal : Sandy loam

Split-plot experimental design at each site, biochar as the main plots

2 BIOCHAR treatments : 0t/ha and 10t/ha

2 hybrid poplars : 3729 : *P. nigra x P. maximowiczii*

915311 : *P. maximowiczii x P. balsamifera*

3 fertilization treatments (0 ; 70 and 140 kg N/ha)

3 years of growth, many parameters have been mesured :

Height, diameter, biomass, leaf nutrient contents, soil carbon and nitrogen contents, carbon contents in wood, CO_2 emissions

Figure 1. Evolution of poplars planting during three years

Results

Figure 2. Average biomass per tree after 2 years (n=240) after 3 years of growth (n= 432) in each site with different treatments.

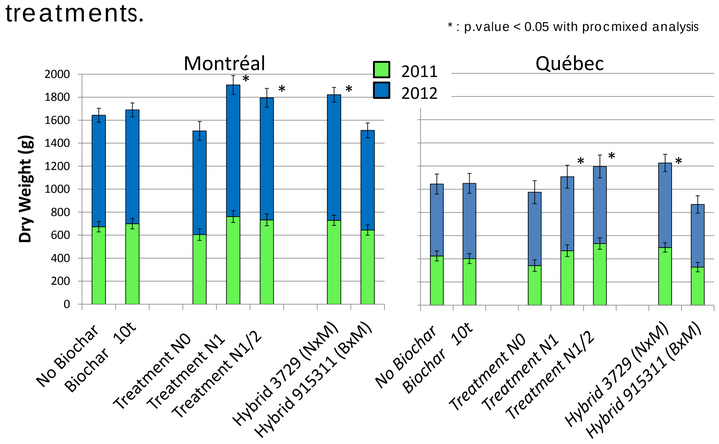
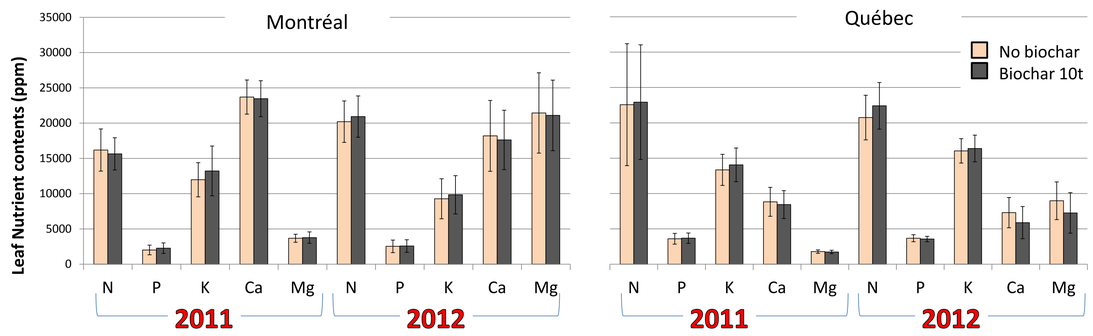
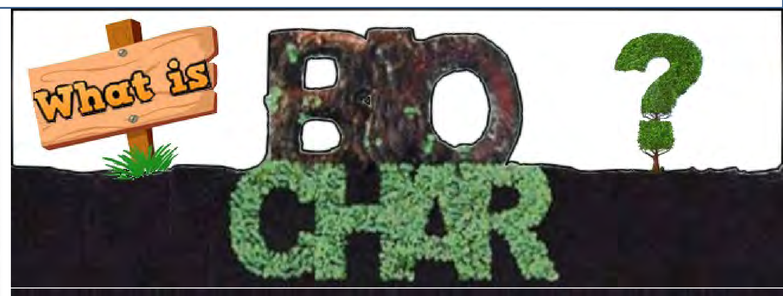


Table 1. Productivity of each site after 3 years of growth (t/ha).

	Montréal	*Québec*
Hybrid 3729	47,34	31,9
Hybrid 915311	39,3	22,59
No Biochar	42,72	27,17
Biochar 10t	43,92	27,32
Treatment N0	39,17	25,34
Treatment N1	49,57	28,81
Treatment N½	46,66	31,11

Figure 3. Average leaf nutrient contents in presence or absence of Biochar. In each plot, 10 trees were sampled at the end of the growing season. Leaves were pooled and ground for analysis.





It's a plant biomass pyrolyzed product that has been suggested to be beneficial to soil and plant production[2]. It may :

- Increase crop productivity by :
  - Improving water retention
  - Improving nutrient retention and cation-exchange capacity of soil especially in sandy soil[3]
  - Modifying soil structure[4] : aeration, builk density, compaction especially in clay soil
- Have environmental benefits :
  - High sorption capacity for pesticides, nitrates, phosphates
  - Stable carbon sequestration in soil[5]

Conclusions

This field experiment suggest that biochar applied at a rate of 10t/ha does not improve production yields of hybrid poplar nor the nutrition of the plants independently of the clone, in contrast to N fertilization.

However, application of biochar does have a negative effect on productivity, particularly important at the Montreal site where yields are interesting for the production of energy.

Environmental benefits such as carbon sequestration should therefore be considered.

Our future research will investigated potential benefits during drought stress.

References

1. MÉNÉTRIER J., 2008, *La naturaliste canadien*, Vol.132, issue 1, p46-54
2. SOHI, S.P. & al., 2009, *Advances in agronomy*, p47-82
3. LIANG, B. & al., 2006, *Soil Sci. Soc. Am. J.*, Vol.70, p1719–1730
4. AMONETTE, J.E., JOSEPH, S., 2009, *Characteristics of biochar: microchemical properties.* p33–52
5. LEHMANN, J., 2007. *Front. Ecol .Environ.*, Vol.5, p381-387.

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