# Biochar incorporation in compost for organic growing media production


Lange Sébastien F.[1], Thériault Laura[2], Ouertani Selmene[1], Charbonneau Julie[1], Marc Charland[2]

1 : Biopterre - Bioproducts Development Center : 1642, rue de la Ferme, Sainte-Anne-de-la-Pocatière, QC, Canada, G0R 1Z0

2 : Berger Peat Moss Ltd.: 121 1er Rang, Saint-Modeste, QC, Canada, G0L 3W0


## Context

1) There is an increase of the demand for organic growing media (OGM).
2) Although peat remains essential for OGM production, its nutrient content is too low for plant production.
3) Compost is often added to OGM in part because of its nutrient content, but the release of nutrients might happen to early for plant needs, resulting in loss of nutrients and unoptimal plant growth.
4) Biochar has shown a capacity to capture many key nutrients and to slowly release them.
5) In Quebec, we have a lot of wood residues that may be pyrolyzed to produce biochar.

## Hypothesis

Biochar can be used as an input in the composting process to promote optimal nutrient exchange of OGM used for plant production.

## Objectives

Compare the nutrient exchange performances of OGM containing compost and biochar whether biochar being added during the composting process or during OGM production to 1) improve the OGM nutrient content and 2) optimize the release of nutrients from OGM with plant development needs.

## Materials & Methods

**Step 1)** Biochar physico-chemical characterisation and fertilizer sorption/desorption - laboratory tests

B1: Hardwood biochar residue from charcoal production
B2: Decommissioned wood feedstock

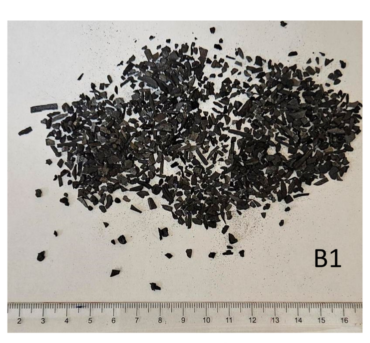




Photo of both biochar with B1 (left) and B2 (right)

**Step2)** Compost production and monitoring:
3 windrows of 30 m³
- C0: Control compost: cow and chicken manures and peat
- Compost with B1 (CB1): B1 (20% v/v); peat (-20% v/v), cow and chicken manures at the same rates.
- Compost with B2 (CB2): B2 (20% v/v); peat (-20% v/v), cow and chicken manures at the same rates.

Monitoring: 3 times a week for temperature, 2 times a week for humidity and 1 time a week for oxygenation rate.

**Step 3)** Compost characterization

**Step 4)** OGM production
OGM treatments were produced with the incorporation of 20% v/v of C0, C1 and C2

**Step 5)** Greenhouse 10 weeks trials on basil production

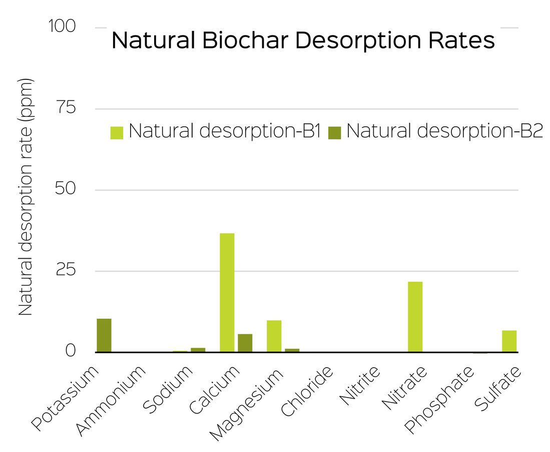
Photo of windrows (left) and basil greenhouse trial (right)

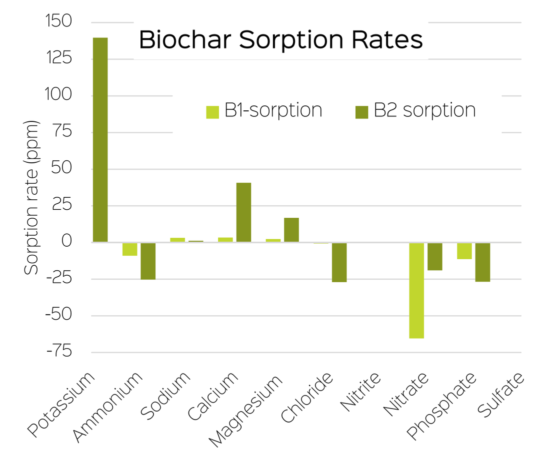
## Results

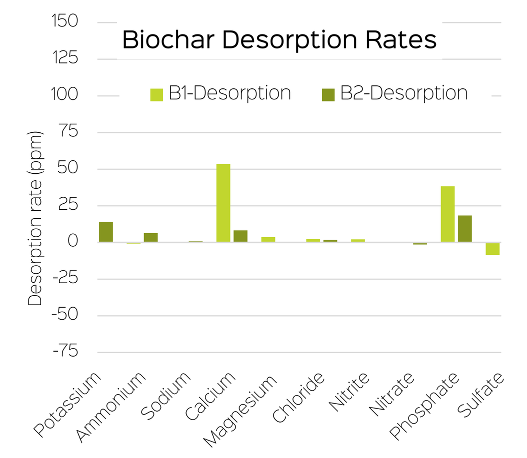
### Biochar properties

| Parameter | Unit | B1 | B2 |
|---|---|---|---|
| pH | | 8.69 | 8.48 |
| EC | µS/cm | 697 | 235 |
| $N-NH_3$ | mg/kg | <10 | <10 |
| Dry matter | % | 88 | 95 |
| K extractible | mg/kg | 7190 | 1920 |
| $K_2O$ | mg/kg | 8630 | 2310 |
| $P_2O_5$ | mg /$kg_{dm}$ | 400 | 400 |
| Ptotal | mg/kg | 1150 | 175 |

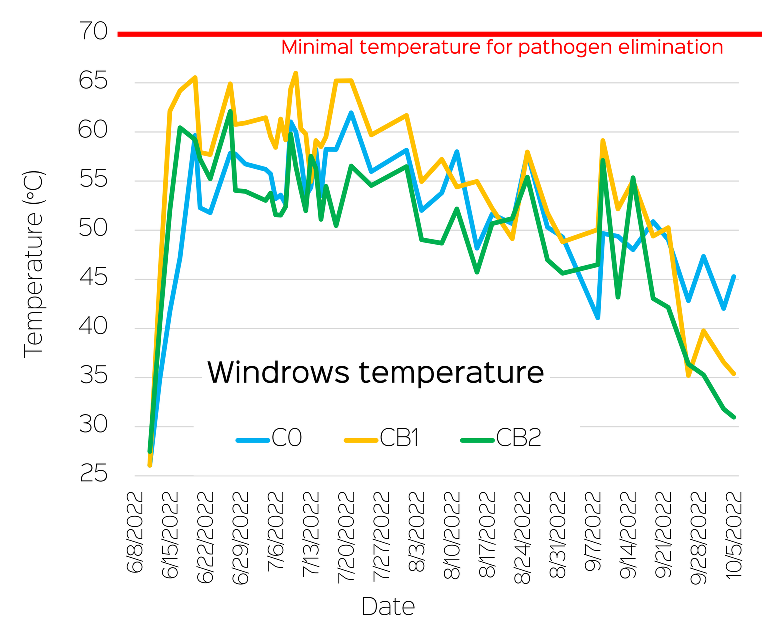
### Biochar sorption and desorption capacity



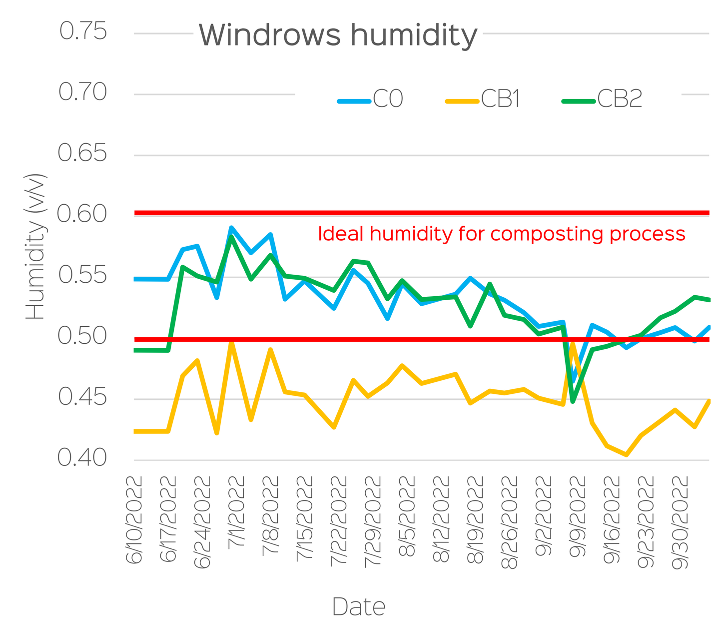




The natural desorption rates of both biochars were very low.
B1 and B2 can adsorb a small part of nitrates and phosphates but no potassium.
Both biochars released in solution a low fraction of calcium and phosphates but almost no nitrates.



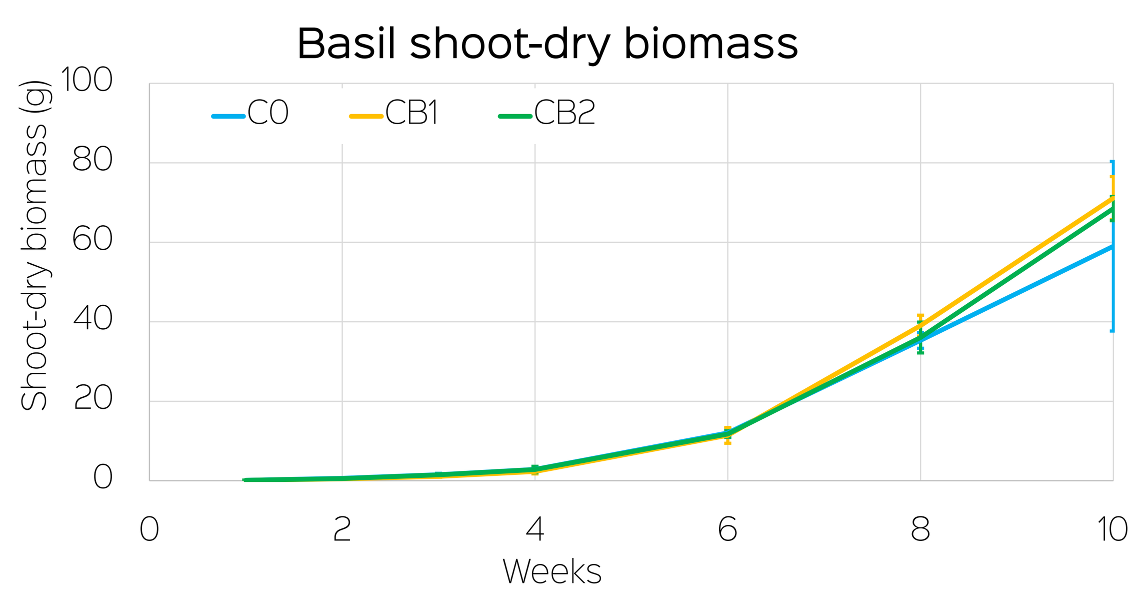

Temperature of composts < 70°C.
CB1 and CB2 initially allowed a stronger and faster temperature increase than C0.
At the end of the season, the drop in temperatures was accelerated by the presence of biochars in the compost (higher aeration?).



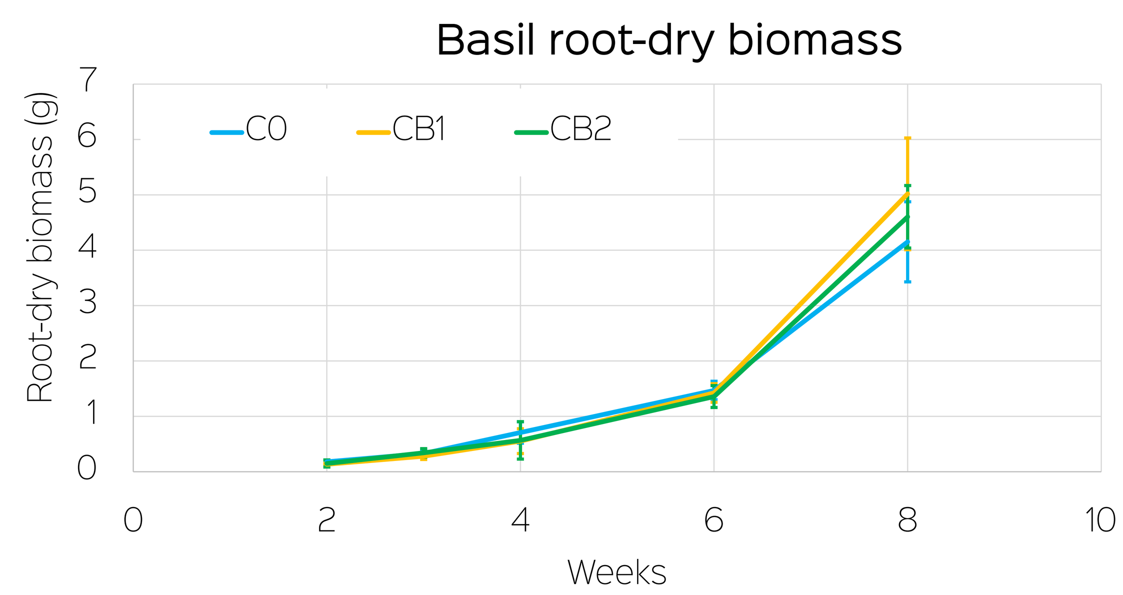

CB1 windrow humidity remained out of optimal composting conditions for most of the season. The darker coloration of CB1, resulting in higher temperature, could have influenced water evaporation.

| Parameter | Unit | C0 | CB1 | CB2 |
|---|---|---|---|---|
| pH | | 7,0 | 7,8 | 7,4 |
| CE | mS/mmol | 11,7 | 12,1 | 9,7 |
| C/N | | 16,1 | 22,5 | 21,4 |
| $NO_3$ | ppm | 321 | 357 | 189 |
| $NH_4$ | ppm | 0,8 | 0,1 | 0,1 |
| N total | % | 1,3 | 1,3 | 1,0 |
| P total | % | 0,3 | 0,3 | 0,2 |
| K total | % | 0,3 | 0,4 | 0,2 |
| Ca total | % | 1,4 | 1,9 | 1,2 |
| Mg total | % | 0,2 | 0,3 | 0,2 |

The three composts have similar agronomical properties except that CB2 has a lower $NO_3$ content despite the fact that the quantity of manure (main source of N) was the same for the three composts ($NO_3$ biochar sorption ?).




Plants which grew in a OGM with CB1 and CB2 had a higher shoot-dry biomass at 10 weeks, by respectively 20 and 16% compared with those grown in C0.




Plants which grew in a OGM with CB1 and CB2 had a higher root-dry biomass at 8 weeks, by 21 and 11%, respectively compared with those grown in C0.

## Conclusions

For nutrients, studied biochars have a low sorption capacity as well as a low desorption capacity, insufficient to modify the dynamics of nutrient release in OGM used for plant production nor to support the plants nutrients needs on a long period.
20% v/v of biochar input in compost process have no major effect on their agronomics final properties but may affect the humidity during the composting process.
Slight gains are obtained on basil plants produced with OGM made from compost with biochar.
However, these results do not show a great influence of studied biochars on the management (quantity and release dynamics) of nutrients necessary to meet the nutrient needs of plant production in growing media.

## Outlooks

Biochar is very useful because it can partially replace peat in OGM, allowing the valorization of forest residues abundant in Quebec and preserving peatlands.
Actually, only on the base on agronomical and economical aspects, other considerations like environment, society, sustainable development, GHG balance, etc. must be reconsidered to promote and support the use of biochar in OGM development.

## Acknowledgments


The authors thank all the members of the Berger Peat Moss Ltd. and Biopterre teams who participated in the acquisition and analysis of the data as well as NSERC for its financial support.