Enhanced Greenhouse Gas Production Potential from Urban Wetland Soils

Tidal wetlands in close proximity to urban centers receive significant anthropogenic inputs from surface runoff, sewage overflow, and treated wastewater. While wetlands are important in global carbon dynamics due to a large carbon soil pool (16–33% of global total), this benefit is offset by potential methane (CH$_4$) and nitrous oxide emission effluxes from these low-oxygen ecosystems. How soluble carbon and nitrogen pollution, typical of anthropogenic inputs, will impact wetland greenhouse gas production rates is unclear.

Researchers publishing their work in the Soil Science Society of America Journal researchers investigated the impact acetate and inorganic nitrogen additions had upon carbon dioxide (CO$_2$) and CH$_4$ production in a series of laboratory incubation experiments with wetland soils of varied salinities. Experiments demonstrated that acetate additions, not inorganic nitrogen additions, enhanced both CO$_2$ and CH$_4$ production rates from all soils. Further, acetate additions lowered redox and increased pH and hydrogen sulfide values—all indications of enhanced anaerobic respiration.

This study provides further impetus to study carbon cycling in urban estuaries as inputs were demonstrated to have a large potential to enhance greenhouse gas production. More measurements will help fill the above need as well as better constrain “hotspots” and “hot moments” of greenhouse gas production, a likely but understudied scenario in anaerobic soils, which receive regular deliveries of urban inputs.


Phosphorus Bioavailability Unaffected by Natural Organics

The strong chemical bonds between phosphorus and soil minerals decrease its solubility in soils and availability to crops. Model organic compounds have been shown to affect phosphorus solubility. Carbon-rich soil amendments may lead to greater phosphorus solubility in soils, but a greater understanding of this process is necessary before management practices can be designed to increase phosphorus use efficiency in cropping systems.

In an article recently published in Agricultural & Environmental Letters, researchers report on an agar-culture bioassay of phosphorus uptake by tomato. Phosphorus sorbed onto an iron mineral, with or without pre-adsorbed natural organic matter, was used as the sole source of plant phosphorus during five weeks of growth. The natural organic matter was extracted with water from manures (beef, horse), crop residues (corn, wheat, and soybean), and compost (food-based).

Although the different types of organic matter caused the quantity of phosphorus sorbed by the iron mineral to decrease by an average of 19%, there was no difference in plant growth or plant phosphorus uptake due to any of the organic matter treatments.

The reason for the inability of the organic matter to affect phosphorus bioavailability is likely due to their different bonding mechanisms to soil minerals (weaker, outer-sphere complexes) compared with phosphorus (stronger, inner-sphere complexes).


Carbon dioxide and methane production in an incubation experiment. Total carbon mineralized as (a) carbon dioxide (CO$_2$[g] + CO$_2$[aq] + HCO$_3^-$) and (b) methane (CH$_4$) over the 14-day course of each incubation. Data are averages of either total mineralized CO$_2$-C or CH$_4$-C for each treatment ± standard errors (n=8) with the corresponding production rate of the no amendment treatment subtracted. This was done to demonstrate the effect of each addition compared to one another.


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