Soil CO_2 Burst on Sand Based Putting Green Soils and the Effect on Creeping Bentgrass Growth

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INTRODUCTION

N is typically the most limiting factor and a driver of turfgrass growth. A precision fertilization plan requires understanding the supply of N from indigenous sources from soil. Soil organic matter is a parameter that can be related to soil N supply, but it can be insensitive to management practices and is not a good indicator for soil N supply over a short time.

Instead, soil CO_2 burst has been shown as a good estimation of soil N supply and correlated with agricultural plants response (Agbim et al., 1977; Mureva and Ward, 2017; Chahal and van Eerd, 2018) and has been used to improve N application decisions. However, whether soil CO_2 burst improve N decision-making for putting green turfgrass is still unknown.

OBJECTIVES

- Investigate correlation between soil CO_2 burst with turfgrass growth and N uptake
- Observe the short- and long-term change of soil CO_2 burst on sand-based putting green soil
- Whether varying inorganic nitrogen (N) rates affect the soil CO_2 burst

METHODS & MATERIALS

The field experiments were conducted from May to Sept. 2020 & 2021, and on four different putting green root zones :

Greens	SOM (%) at 0-10 cm
High SOM$^{\Phi}$	0.98
Med-high SOM	0.89
Medium SOM	0.59
Low SOM	0.37

$^{\Phi}$SOM: soil organic matter

Completed randomized design with three N rates :

- Non-fertilized control
- 5 kg N ha^{-1} $2wk^{-1}$
- 10 kg N ha^{-1} $2wk^{-1}$

Soil was collected every three weeks at 0-10 cm depth. The following is soil analysis process:

- Air-dried for at least 7 days
- Ground and passed through 2 mm sieve
- Add D.I. water to reach 50% water-filled pore space
- Incubate wetted soil at 25 °C for 24 hour
- Soil CO_2 burst was measured with CO_2 analyzer (LI-COR 820, LI-COR Biosciences, Lincoln, NE, USA)

Clipping yield was collected three times every week, samples were dried and weighed

Clipping N content was measured every three weeks using a combustion analyzer with thermal-conductivity-detection (TruSpec Micro, LECO Corporation, St. Joseph, MI)

RESULTS

N rate (kg ha^{-1} $2wk^{-1}$)	Soil CO_2 burst (mg kg^{-1} d^{-1})			
	High SOM	Med-high SOM	Medium SOM	Low SOM
0	47.66 a	45.79 ab	35.50 c	38.60 c
5	50.92 a	47.66 a	37.68 c	39.13 bc
10	48.44 a	48.24 a	39.58 bc	39.44 bc

Table 1. Soil CO_2 burst response to three N rates and SOMs of four putting greens.

Soil CO_2 burst was not affected by different soil organic matter content, but not various inorganic N fertilizer rates.

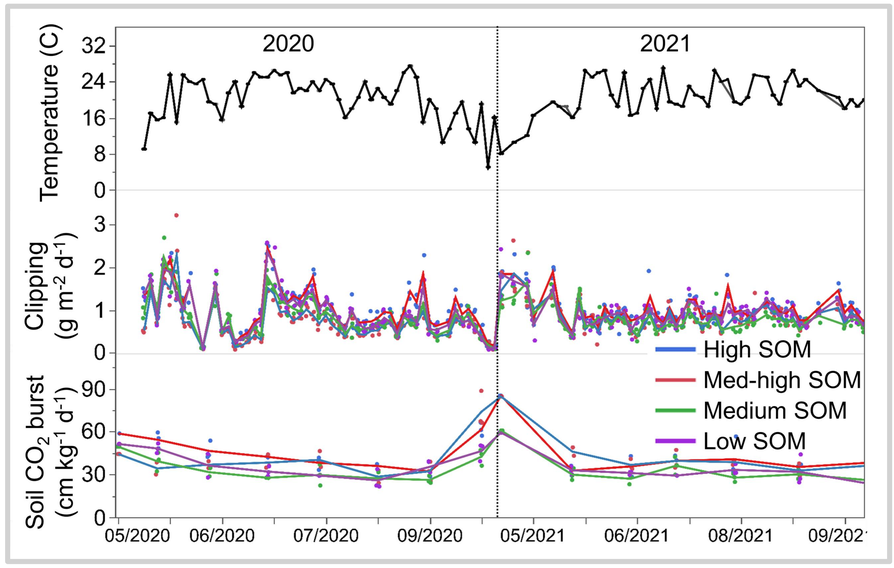

Figure 1. Annual change of soil CO_2 burst and creeping bentgrass clipping yield on four different putting greens in 2020&2021, and corresponding average air temperature.

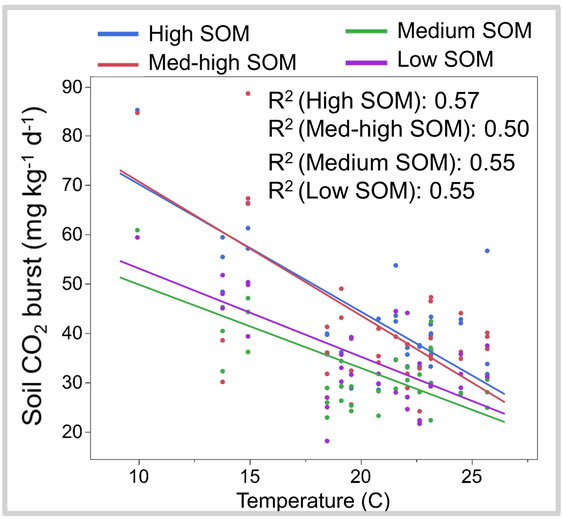

Figure 2. Negative correlation between weekly air temperature (field) and soil CO_2 burst.

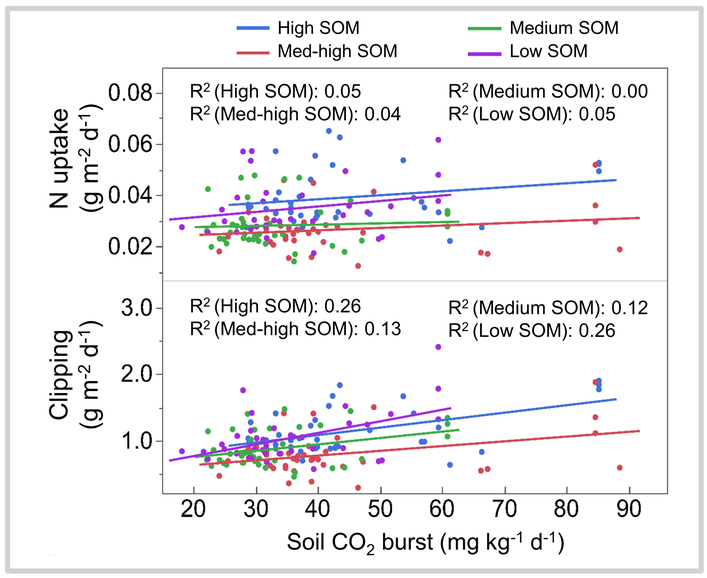

Figure 3. Correlation among soil CO_2 burst, bentgrass clipping yield and N uptake in 2020 & 2021 on four putting greens.

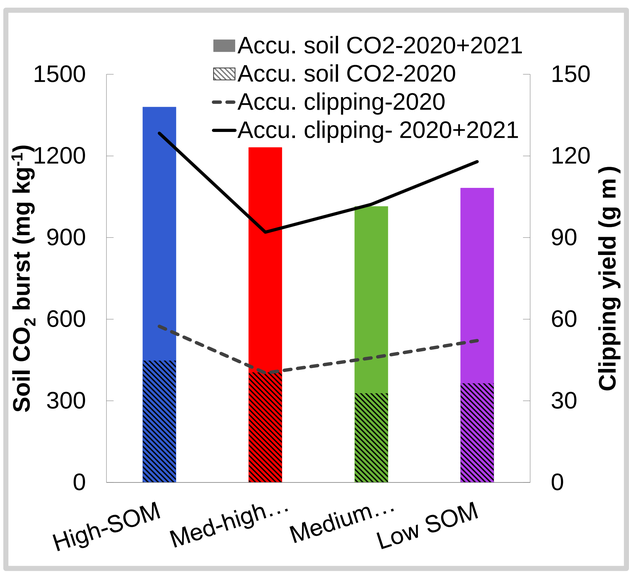

Figure 4. Accumulative soil CO_2 burst and bentgrass clipping yield from 2020 and 2021 on four putting greens.

CONCLUSION

Soil CO_2 burst was not affected by various inorganic nitrogen fertilizer rates but was affected by SOM content. Air temperature in the field was negatively correlated with soil CO_2 burst. Moreover, short-term and long-term soil CO_2 burst had weak correlations with creeping bentgrass clipping yield and corresponding N uptake on four research greens. Soil CO_2 burst cannot be solely used to estimate turfgrass growth and nitrogen need.

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