METHANE EMISSIONS FROM A COLORADO GOLF COURSE: EFFECTS OF SOIL DRAINAGE

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ABSTRACT: Methane is an important greenhouse gas, and soils act as both a source and a sink, thus influencing atmospheric concentrations. Due to intensive management and expanding areas, these urban ecosystems are increasingly important to regional studies of greenhouse gas budgets. In 2011 (YEAR1), a field site was selected on a golf course that included fairway, rough, and restored native area. Measurements of soil bulk density and annual water filled pore space (WFPS) indicated that the first site had poor drainage. Methane emissions in 2011 totaled 0.55, 0.36 and 0.31 kg CH_4-C ha^{-1} yr^{-1} from fairway, rough, and native sites, respectively. In 2012 (YEAR2), a second field site was selected on a well-drained soil at the golf course. In 2012, emissions from the poorly-drained fairway, rough and native grass areas totaled 0.58, 0.76, and 0.40 kg CH_4-C ha^{-1} yr^{-1}, and emissions from well-drained fairway and rough totaled 0.38 and 0.01 kg CH_4-C ha^{-1} yr^{-1}, respectively, with 0.14 kg CH_4-C ha^{-1} yr^{-1} net methane consumption at the well-drained native site. Soil was observed to be largely saturated at poorly drained sites, and soil compaction was correlated to reduced methane oxidation. Increased soil aeration lowered soil emissions and increased oxidative capacity at the well-drained field sites. There was an observed "turfgrass effect" from golf course field sites, indicating that highly managed turfgrass may have a greater effect on atmospheric methane concentrations by reducing soil oxidation and increasing methanogenesis than previously considered.

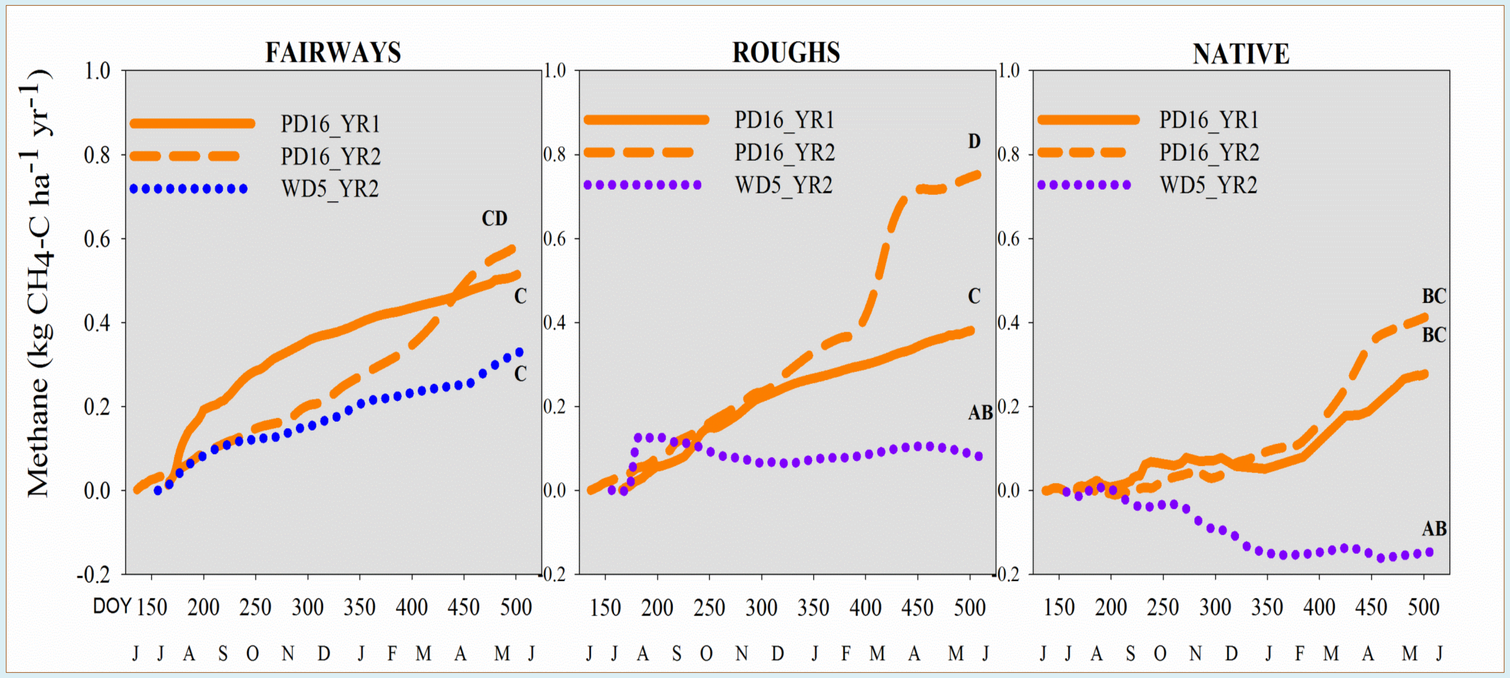
- **Poorly drained (PD) site:** YR1=2011-2012, YR2=2012-2013
- **Well-drained (WD) site** YR2 only 2012-2013

- **Trace gas sampling intervals** 0-,15-,and 30- minutes
- **Gas chromatograph** equipped flame ionization detector for CH_4

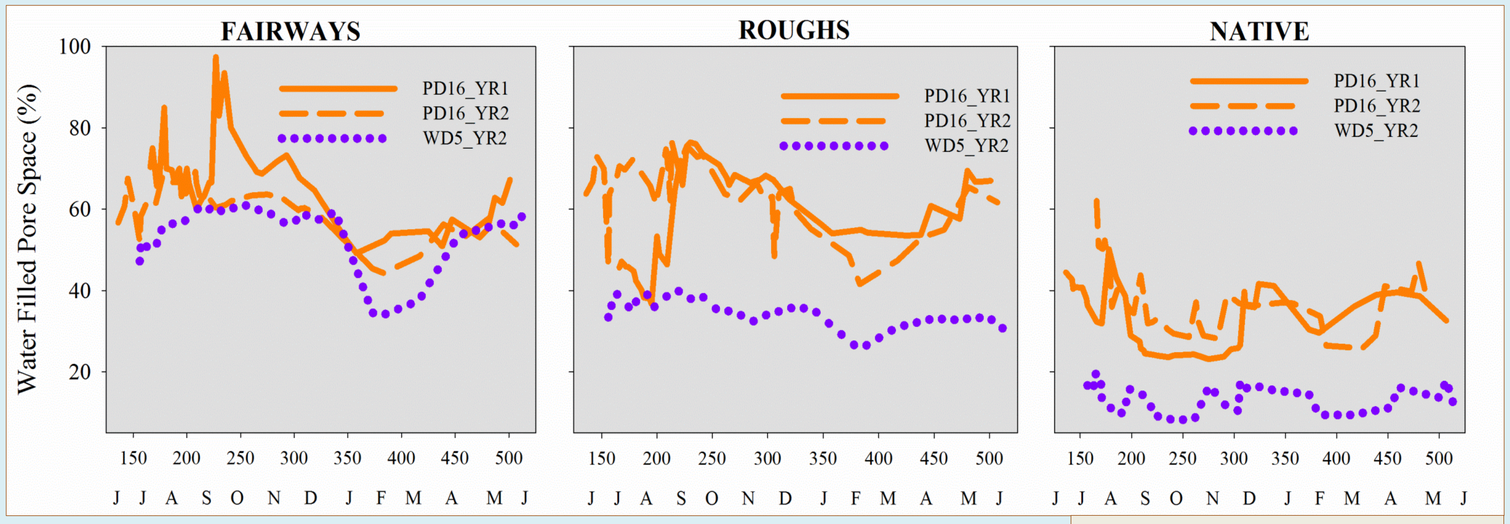
PROC MIXED linear model test for effects of site, year and drainage

Vented Chamber Method

Cumulative Methane Emissions



Water Filled Pores Space



*PD16 =Poorly-drained
*WD5=Well-drained

Field Site Characteristics

Site	Drainage	Year	Bulk density	Soil WFPS	Soil organic matter	NO_3-N
			g cm^{-3}	%	g kg^{-1} soil	mg kg^{-1} soil
Fairway	Poorly-drained	2011	1.43	67	16.3	25.6
Rough	Poorly-drained	2011	1.52	58	14.5	37.4
Native	Poorly-drained	2011	1.42	33	1.0	1.0
Fairway	Poorly-drained	2012	NA	60	NA	NA
Rough	Poorly-drained	2012	NA	65	NA	NA
Native	Poorly-drained	2012	NA	40	NA	NA
Fairway	Well-drained	2012	1.10	50	19.5	10.5
Rough	Well-drained	2012	1.09	40	17.2	7.5
Native	Well-drained	2012	1.14	20	0.6	1.1

*NA indicates that measurement were not taken for that year

Conclusion

- There was a site effect for methane emissions between golf course turfgrass sections managed as fairways, roughs and restored native sections
- Turfgrass was typically a steady weak source of methane year around, on the fairway and rough
- Study data suggest that nitrogen fertilization and irrigation applications significantly affect methane production and oxidation potentials on soils managed at golf courses
- By increasing soil aeration, soil oxidation potentials can be increased, as was observed at well-drained field sites
- Findings indicate that intensely managed urban grasslands, such as golf courses, may have significantly greater effects on atmospheric methane concentrations than previously considered.

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