FOREST AND GRASSLAND COVER TYPES REDUCE HETEROTROPHIC BUT INCREASE AUTOTROPHIC RESIRATION FROM AGRICULTURAL SOILS

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MOTIVATION

Introduction

- Integrating trees and shrubs into crop and livestock production systems (agroforestry, AF) has potential for mitigating increases in atmospheric CO_2 concentrations
- The need to understand the impact of land management on net ecosystem carbon balance, the components of soil respiration:
  - -Autotrophic (Ra, root) and heterotrophic (Rh, microbial) respirations. The Rh causes soil carbon to be lost and contributes to global warming
- While Ra and Rh can each account for about 50% of total soil respiration, this ratio varies widely among ecosystems

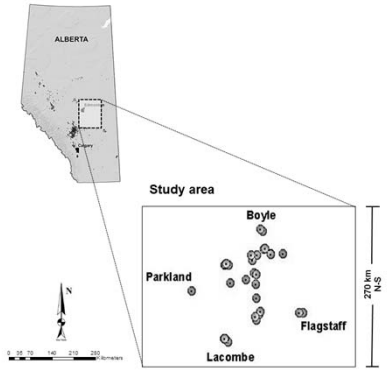
Objectives

- To examine the impact of three agroforestry systems (hedgerow, shelterbelt, silvopasture) and their component land cover type (forest and herbland areas without trees) on Ra and Rh ratio

MATERIALS & METHODS

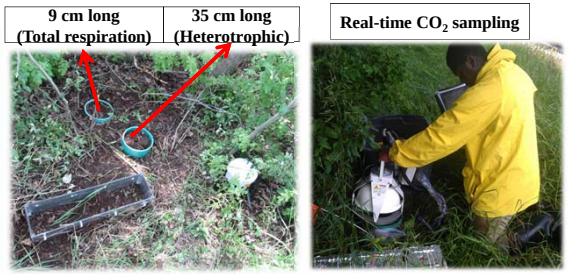
Study area

Study sites were distributed across a 270 km long soil/climate gradient of increasing moisture availability from south to north in Alberta, Canada



Experimental design and sampling

- 36 sites: 12 each of hedgerow, shelterbelt (white spruce dominated) and silvopasture (aspen dominated) sites
- In each site, plots were set up in the forested area and in the herbland areas (both grazed pasture and annual crop)
- Environmental parameters and Ra and Rh (using a modified root exclusion method) were determined over two growing seasons in 2013 and 2014



RESULTS

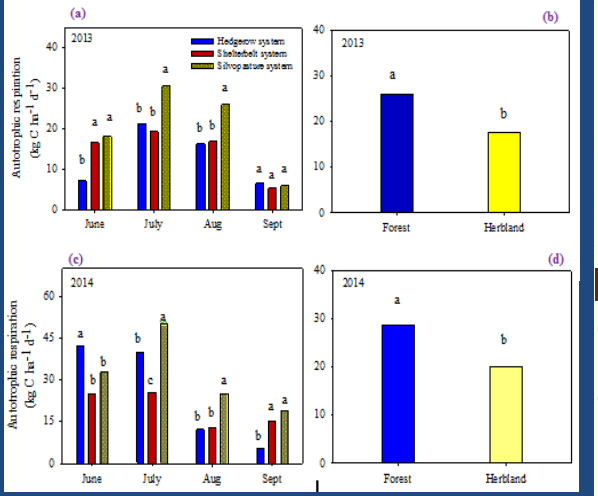


Figure: Measured soil Ra: a) and c): interaction effect of agroforestry and date of sampling, and b) and d): effect of land cover type

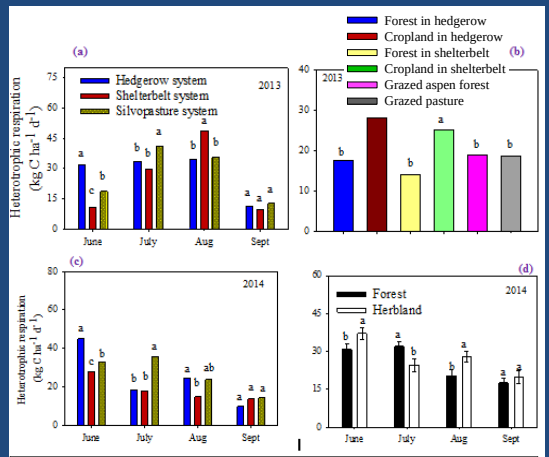


Figure: Measured soil Rh: a) and c): interaction effect of AF and date of sampling, b) interaction effect of AF and land cover type, and d) interaction effect of land cover type and date of sampling

Table: Agroforestry system and land cover type effects on heterotrophic to total respiration ratio [mean (SE)]

Treatment	Ratio of heterotrophic to total respiration (%) 2013	2014
Agroforestry		
Hedgerow	68 (2.4) a	49 (2.1) a
Shelterbelt	64 (3.4) a	45 (4.1) a
Silvopasture	54 (2.9) b	48 (3.1) a
$LSD_{0.10}$	3.56	0.20
Prob > F	0.03	0.81
Land cover type		
Forest	52 (2.8) b	46 (3.2) b
Herbland	60 (3.0) a	57 (2.6) a
$LSD_{0.10}$	23.62	21.21
Prob > F	<0.01	<0.01

CONCLUSIONS

- Over the two growing seasons, mean Rh across all treatments was 54% of the total respiration
- Within agroforestry systems, Rh accounted for more of the total respiration in herbland (59%) than in forest land cover type (41%)
  - more soil C was being mineralized and released to the atmosphere in the herbland
- Maintaining perennial vegetation cover reduces microbial CO_2 emissions from agricultural soils

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