

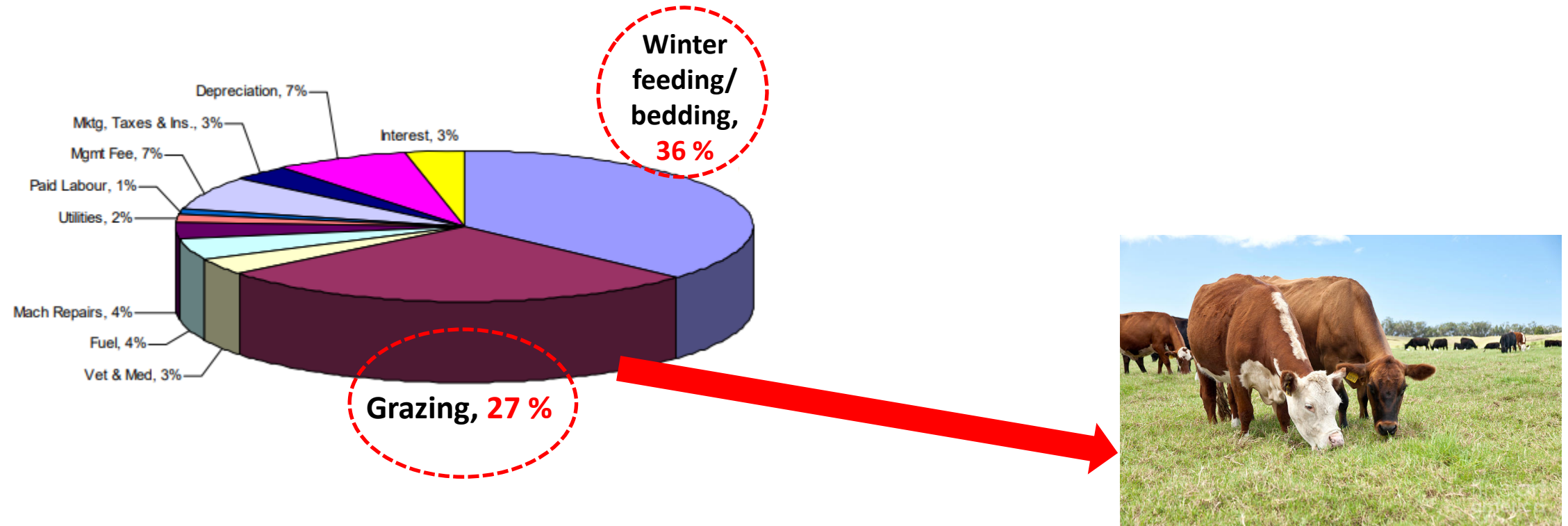
How does tillage as a forage termination method affect soil C and N fractions in grazed pasture systems?



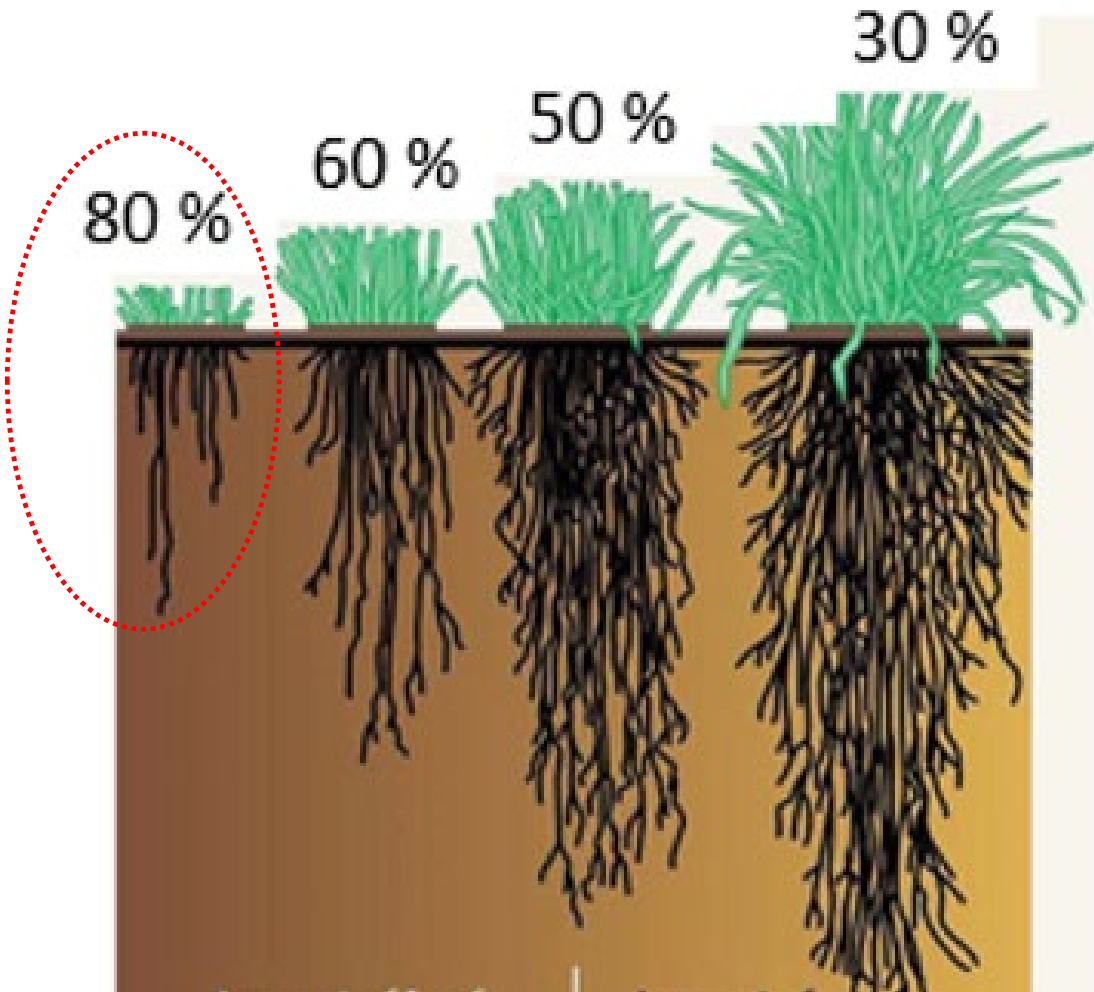
Gazali Issah, PhD candidate
Department of Soil Science, University of Saskatchewan

Grazing and feed cost

- 70 % of the beef cattle in western Canadian prairies are in cow-calf operation.



Effects of grazing on SOC



- Grazing in pastures increases SOC stock:
 - stimulates aboveground production, root respiration and exudation rates.
 - increases tillering & rhizome production.
- Overgrazing decreases SOC stock.

Pasture rejuvenation mechanisms

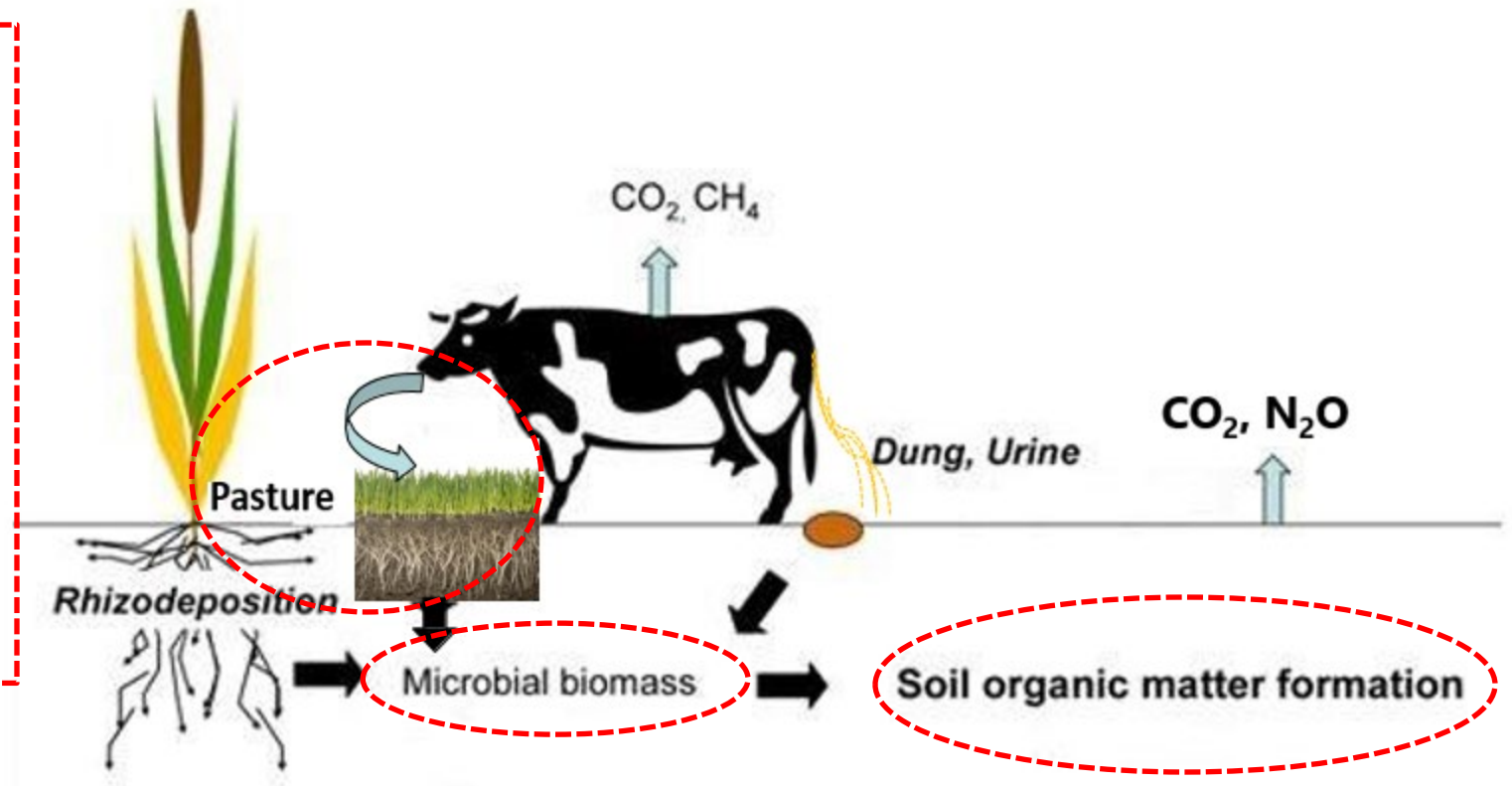
- ❖ Fertilization
- ❖ Mechanical aeration
- ❖ Breaking up stand and re-seeding (e.g. **tillage**)
- ❖ Direct/sod-seeding



Grazing pasture systems: *problem with alfalfa*



Frothy bloat

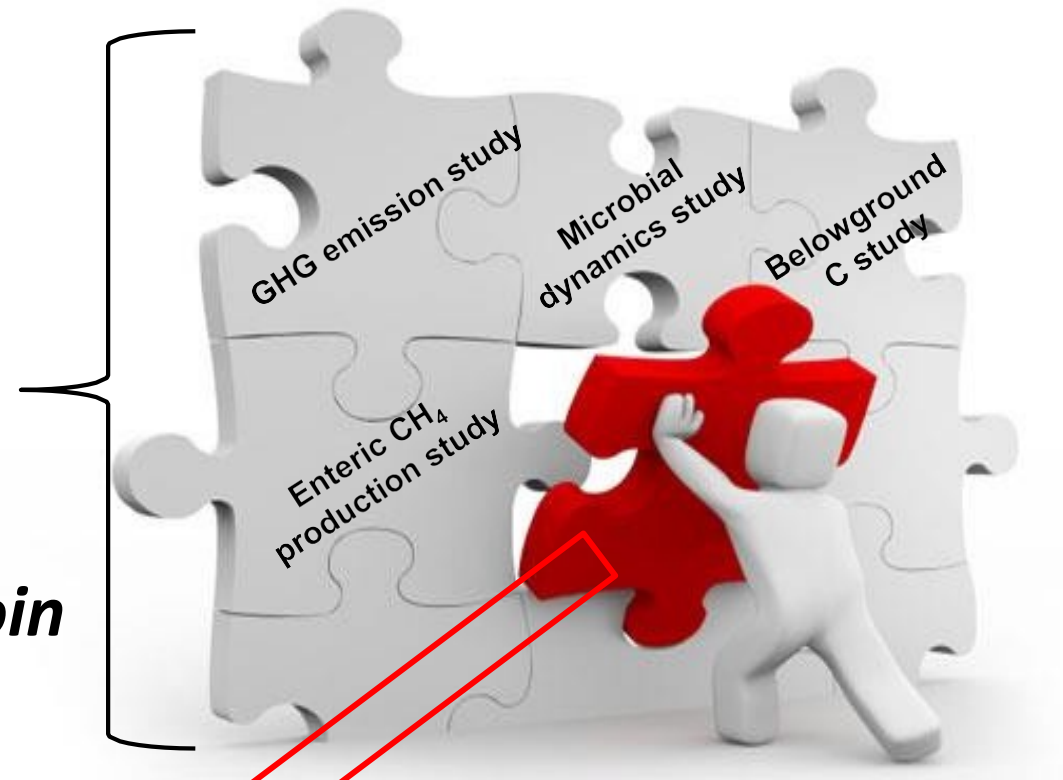


(Modified from Rumpel et al., 2015)

AGGP II Project

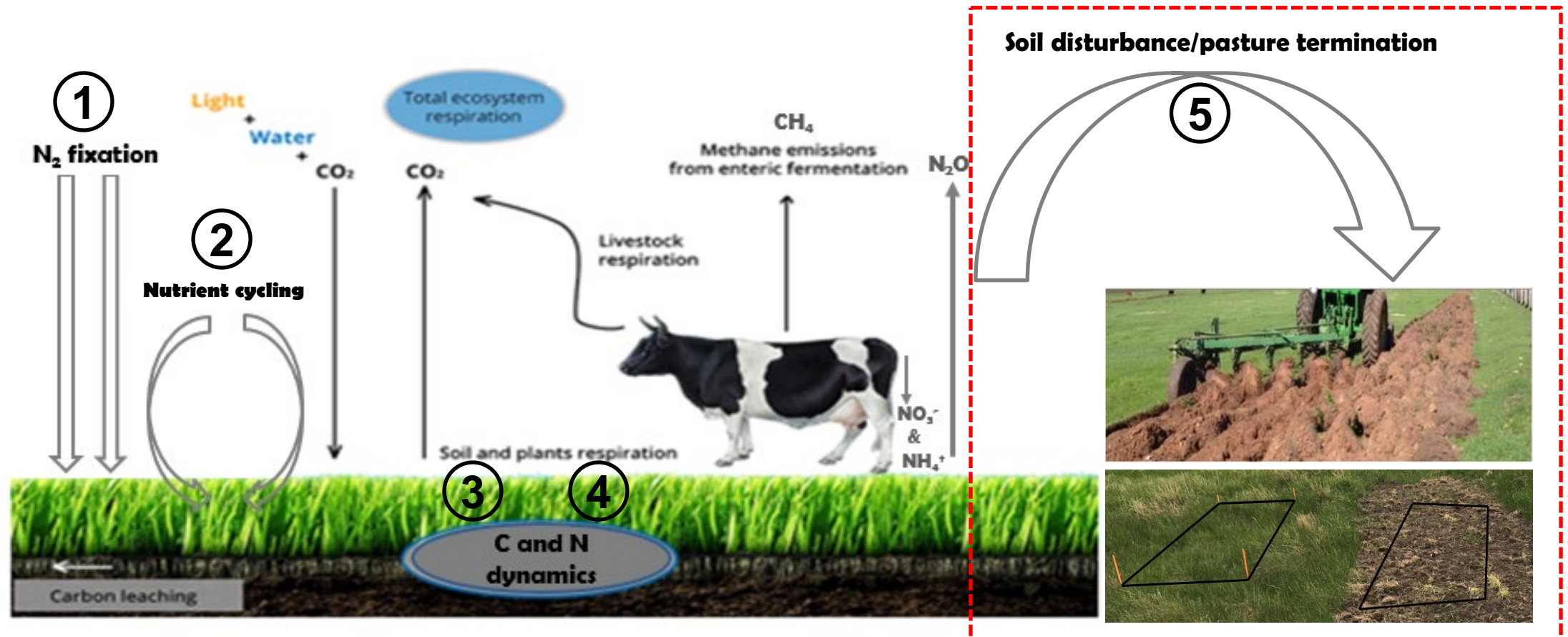
Impacts of forage quality improvement strategies on GHG emissions and C sequestration.

*Using **cicer milkvetch** and **sainfoin** as replacements for **alfalfa**.*



Impacts of cicer milkvetch and sainfoin on C and N dynamics

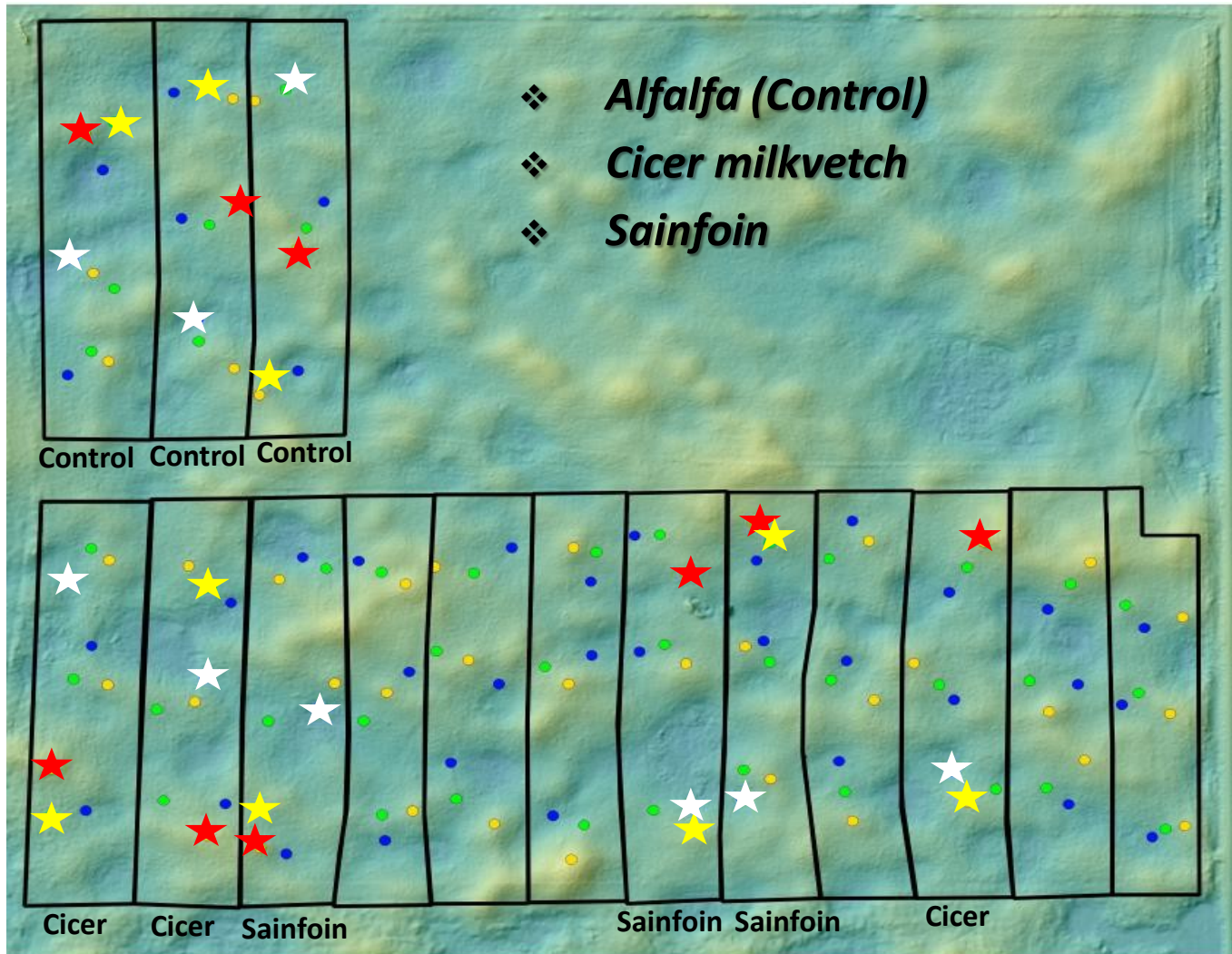
To determine the impact of termination of legume-grass grazing pastures by tillage on soil C and N fractions



Does tillage affect C and N fractions in the short-term?

Do the legumes have a similar response to tillage?

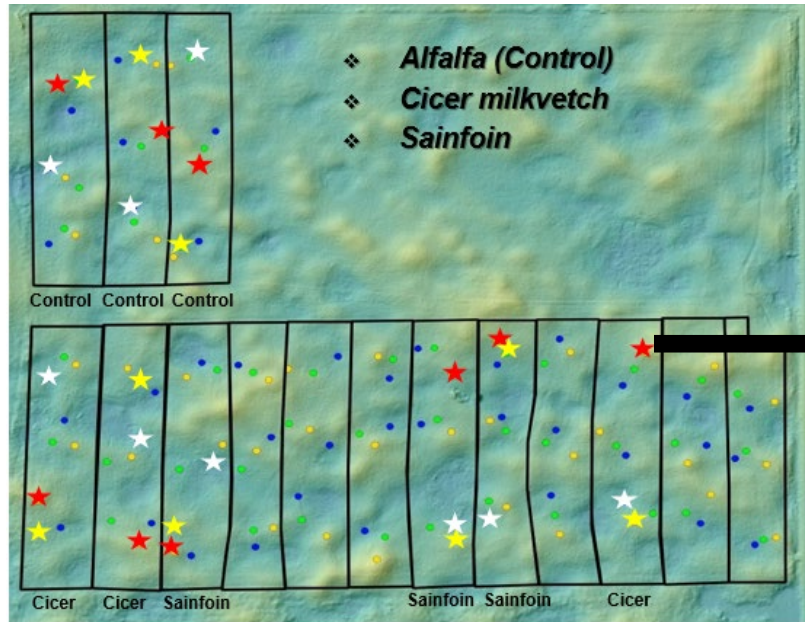
Study site and plot layout



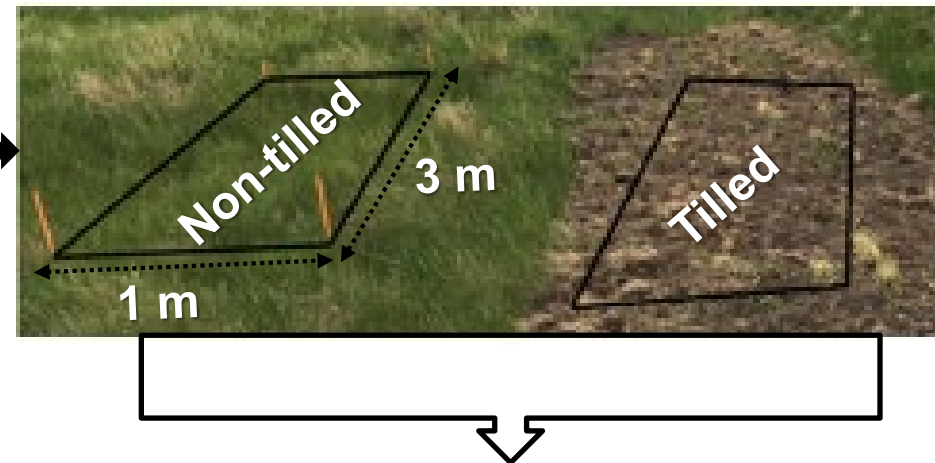
- *Lanigan, SK @WBDC*
- *Alfalfa/bromegrass since 1998*
- *Cicer and sainfoin sod-seeded in 2015*
- *15 paddocks ~ 5 acre each*

Standard (Control)	Standard (Control)	Standard (Control)															
			Open										Zone 3				
													Zone 2				
13	14	15											Zone 1				
	12	11	10	9	8	7	6	5	4	3	2	1	Zone 1				
													Zone 2				
													Zone 3				
Oxley II CMV Blend	Oxley II CMV Blend	Mountain view Sainfoin Blend	Common Sainfoin	Veldt CMV	Common Sainfoin	Mountain view Sainfoin Blend	Mountain view Sainfoin Blend	Veldt CMV	Oxley II CMV Blend	Common Sainfoin	Veldt CMV						

Methodology



- ❖ Tillage done in late fall 2018 (October 15) using a rototiller.
- ❖ Two 3 m x 1 m microplots were established at each positions.



- ❖ Feed barley was seeded in the tilled plots in spring 2019.
- ❖ Grazing: 3 steers and 1 cow for 34 days

- 0-10 cm**
- Dissolved organic C (**DOC**)
 - Total dissolved N (**TDN**)
 - Microbial biomass C (**MBC**)
 - Microbial biomass N (**MBN**)

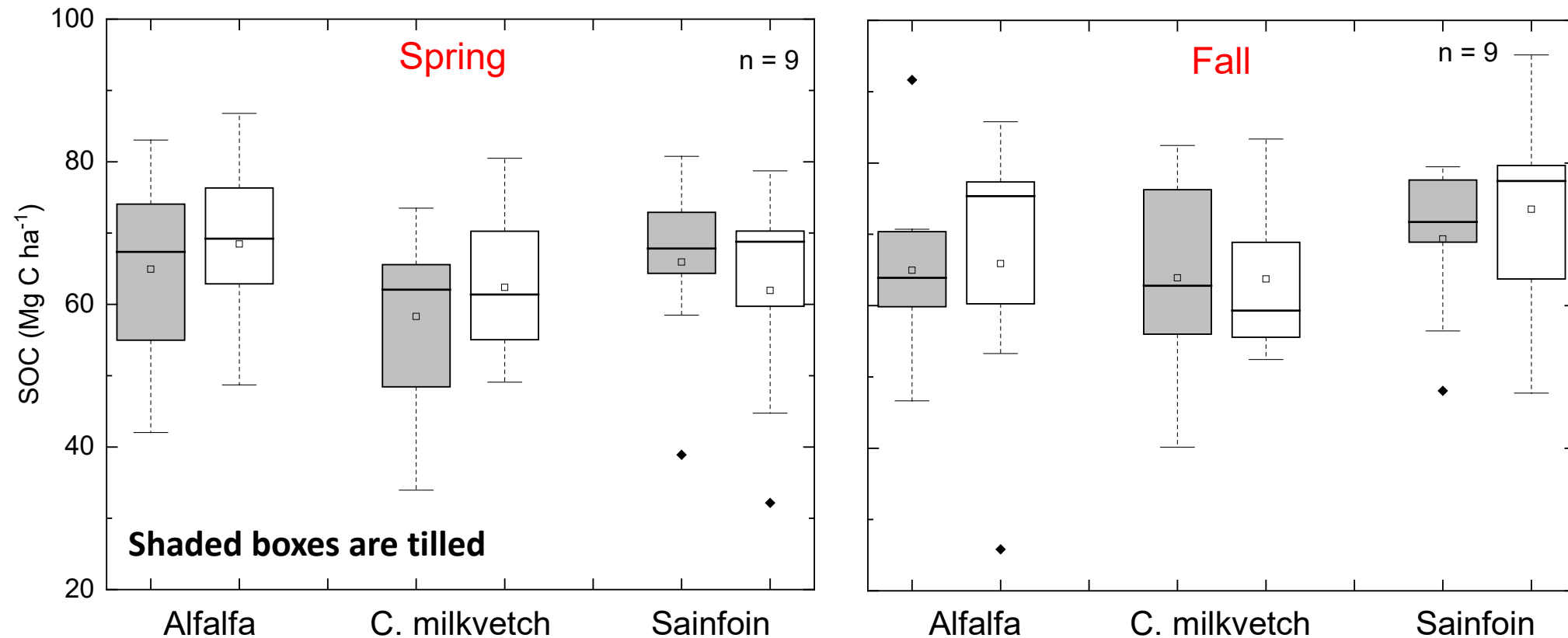
Spring, summer and fall



- 0-15 cm**
- **Total soil organic C (SOC)**
 - Inorganic nitrogen (**NO₃⁻** and **NH₄⁺**)
 - Light fraction organic matter

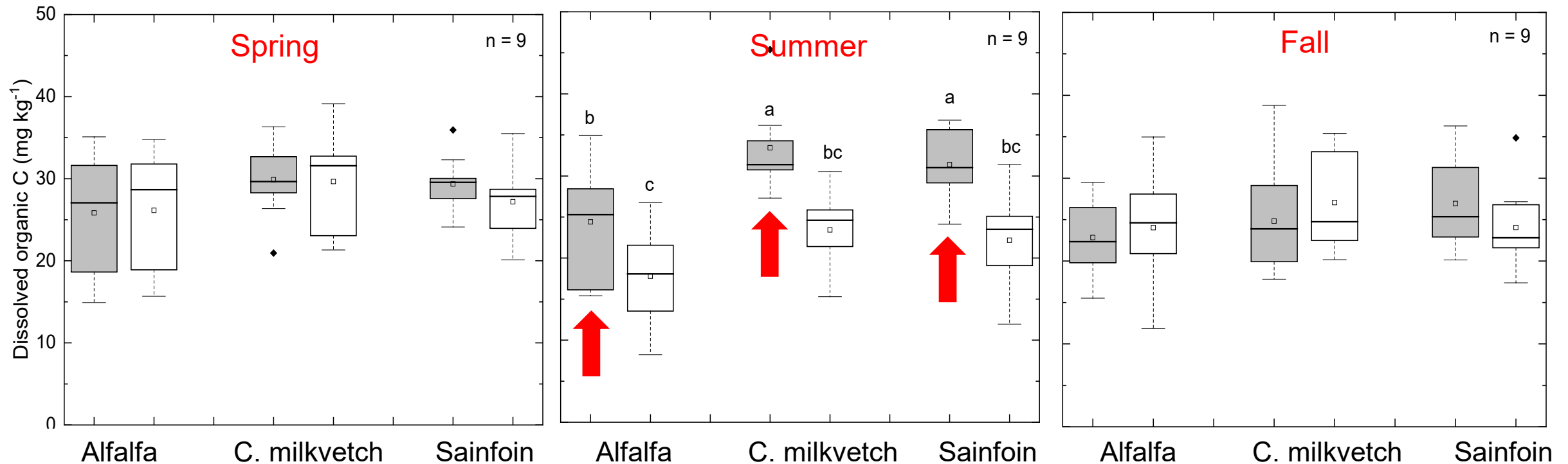
Spring and fall

Total soil organic C (SOC)



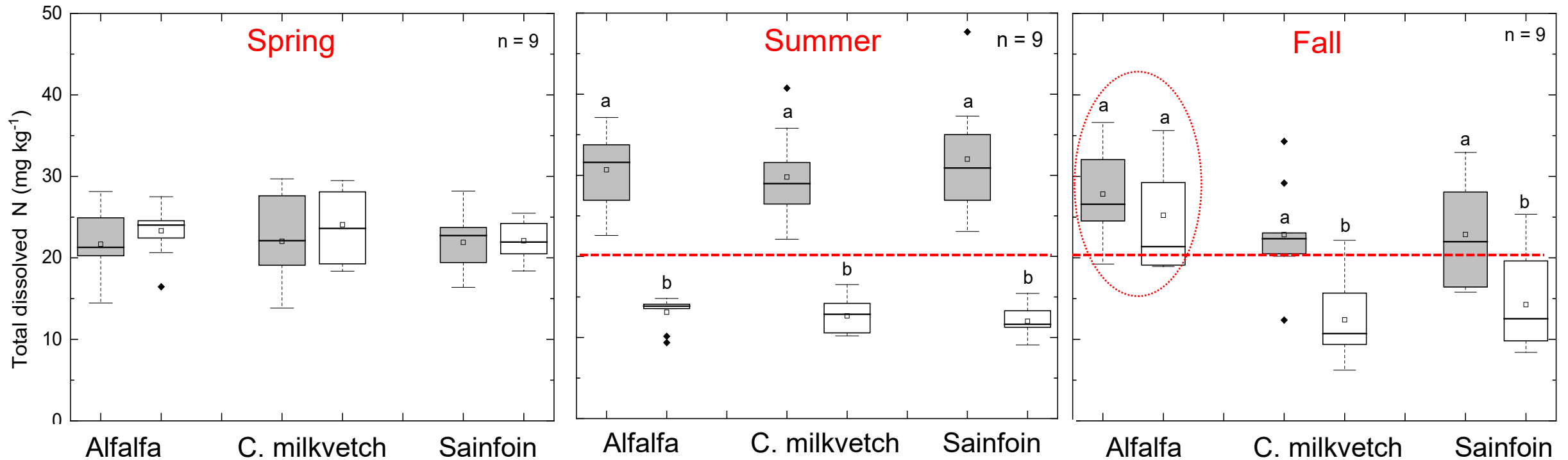
- ❖ *All parameters were analyzed using Proc Mixed, Tukey's HSD at $p \leq 0.10$.*
- ❖ *No significant effects of pasture legume species or tillage on total SOC in both spring and fall. All the legume species had similar total SOC.*

Dissolved organic C (DOC)



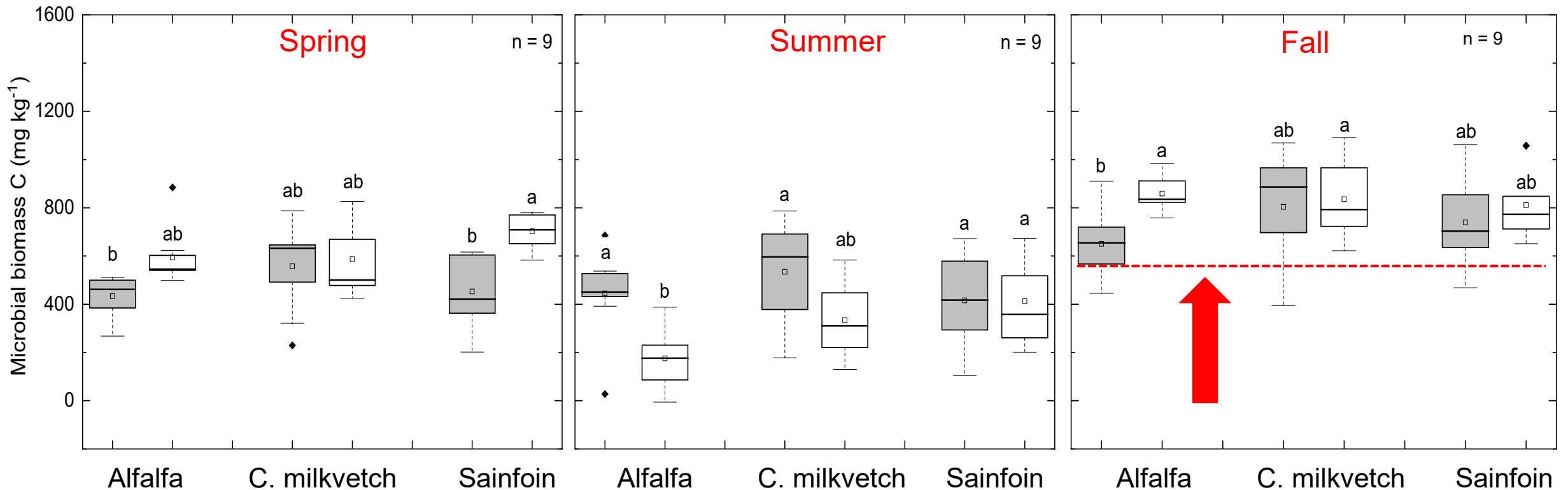
- ❖ Except in the summer, legume species and tillage did not affect DOC.
- ❖ In summer, tillage resulted in higher DOC due to ↑ OM decomposition.
- ❖ Cicer milkvetch and sainfoin tended to have higher DOC than alfalfa.

Total dissolved N (TDN)



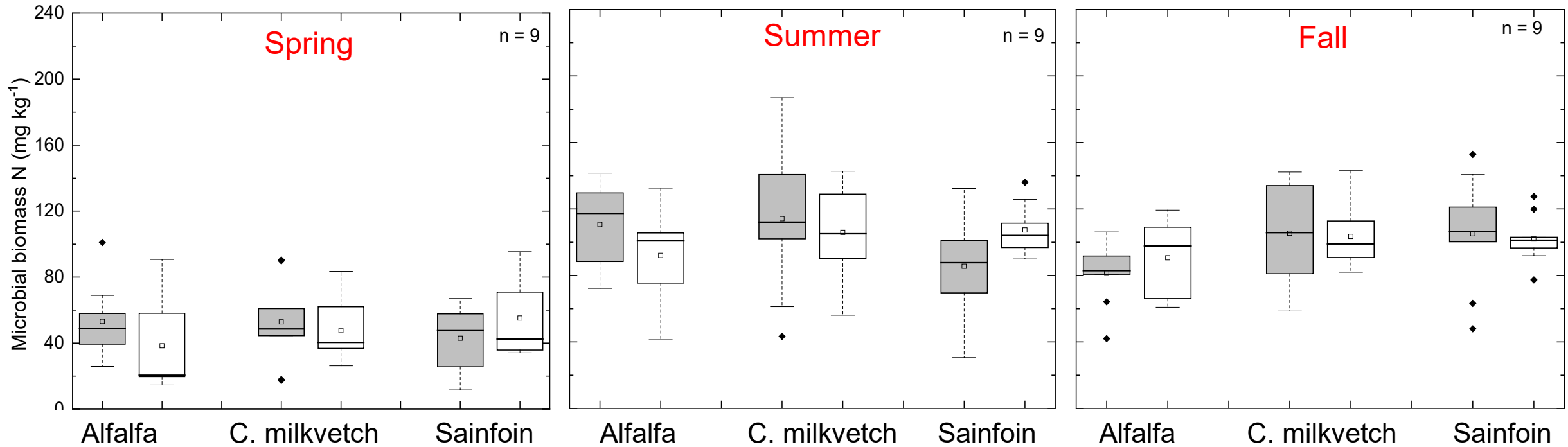
- ❖ Tillage led to higher TDN by the summer/fall.
- ❖ Higher TDN with tillage due to increased depolymerization of OM.
- ❖ Alfalfa had higher TDN than cicer milkvetch and sainfoin by fall.

Microbial biomass C (MBC)



- ❖ MBC increased from spring to fall, with tillage leading to higher (29-50 %) MBC by the fall.
- ❖ *MBC in the tilled treatment was lower than non-tilled at the end of the study.*

Microbial biomass N (MBN)



- ❖ Neither legumes nor tillage had significant effect on MBN.
- ❖ Similar to TDN, MBN increased from spring to summer.
- ❖ All the legume species had similar MBN.

Discussion

- ❖ No measurable effects of tillage on total SOC a year after tillage:
 - ❖ One tillage in this study, usually 5-7 passes are needed to completely terminate a stand (Hall, 2016).
- ❖ Increase in DOC and TDN (**spring to summer**) followed by a decrease from **summer to fall** in tilled treatment may indicate gradual depletion of OM following tillage (Chantigny, 2003).
- ❖ The increase in MBC from **spring to fall** may be a movement towards establishing a new equilibrium following the tillage (Helgason et al., 2009).

Conclusion and Take Home Message

- ❖ Tillage did not affect total SOC mass; other C and N fractions were affected following tillage:
 - *Labile C and N fractions tended to follow the expected pattern of increased OM depolymerization/decomposition due to tillage (non-tilled > tilled).*
- ❖ All the legume species had similar response to tillage.
- ❖ *C. milkvetch and sainfoin are viable alternatives to alfalfa for pasture rejuvenation.*
- ❖ *Sod/slot-seeding may have reduced effect compared to tillage.*

Acknowledgements

Canadian Agricultural Partnership – Agriculture Greenhouse Gases Program (AGGP II).



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada

Department of Soil Science & College of Agriculture and Bioresources.

❖ Scholarships and Bursaries.

Supervisors: J. Diane Knight and Jeff Schoenau.

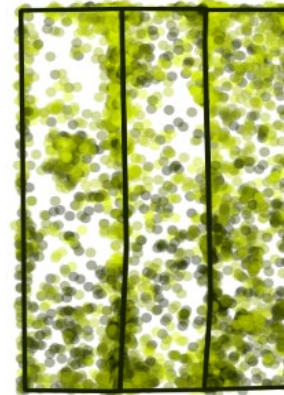
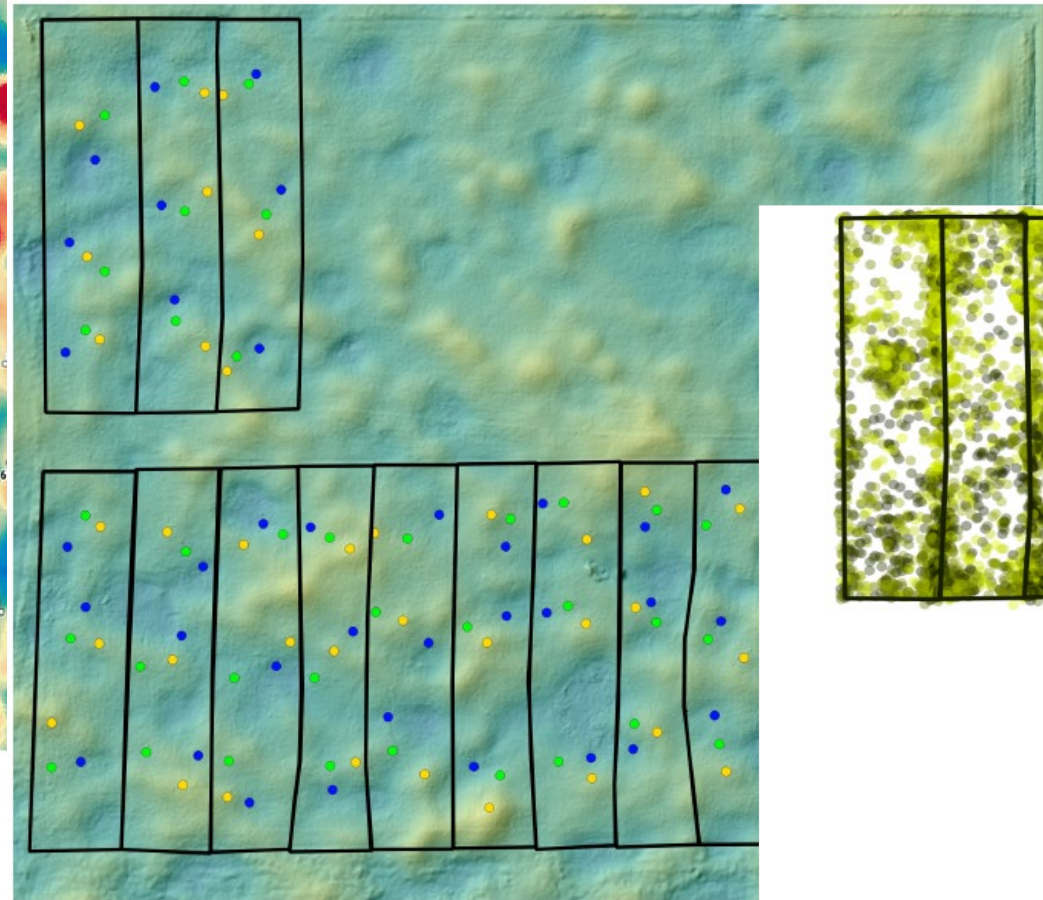
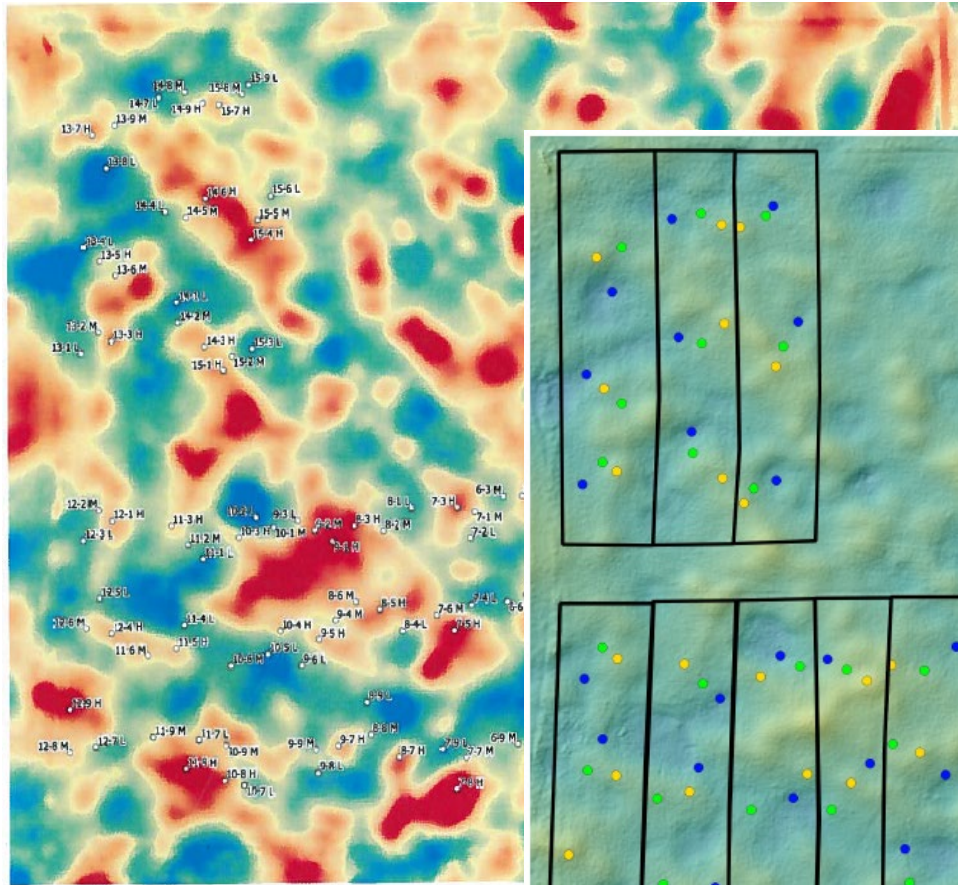
Committee members: Herbert A. Lardner, Derek Peak, Melissa Arcand,
and Kate Congreves.

Lab groups 5E19, 5C21 and AGGP II project group members.

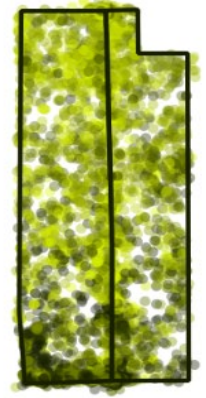
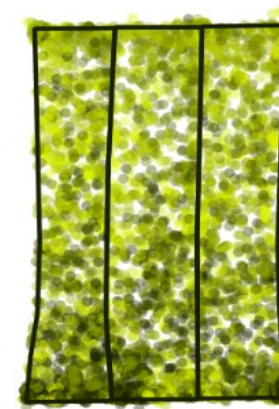
Questions?



Topographic position index maps



Diurnal GPS tracking



Grazing duration information

Year	Number of animals		# of grazing days
	Steers	Cow	
2016	5	1	70
2017	4	1	21
2018	3	1	35
2019	3	1	34

- ❖ Pasture productivity (expected average daily gain (ADG))
 - ❖ Weather condition (especially precipitation)