Impacts of Integrated Crop-Livestock System on Soil Health Parameters in South Dakota

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Introduction

- Integrated Crop-Livestock (ICL) system may promote diversification of existing cropping system, enhance soil health and increase multiple temporal use of marginal yielding land.

Objectives

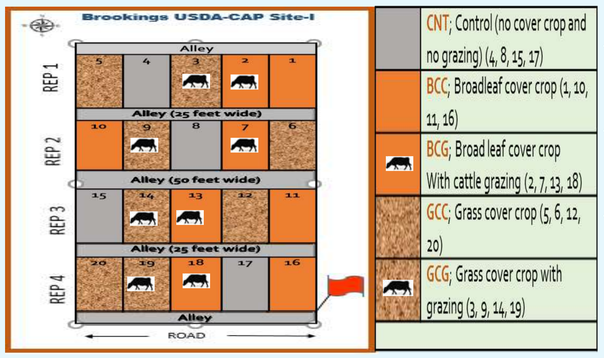
- Analyzing impacts of ICL system on selected soil health parameters in South Dakota.

Materials and Methods

- **Experiments setup**: South Dakota State University, Brookings Research Farm, SD. Soil Type: Fine-silty, mixed, superactive, frigid pachic Haplustoll (Mollic Epipedon) **(Fig. 1)**.

- **Fig. 1.** Experimental field

- **Treatments** : Two cover crops and two grazing system with a control treatments were under ICL system **(Fig. 2).**



- **Fig. 2.** Layout map of study site at Brookings, SD;
- Plot size is of 60 feet (wide) x 90 feet (length) size.
- Randomized complete block design.

- **Planting and grazing:** cover crops was planted on June, 2016 and grazing was started on 15 Nov to 24 Nov, 2017.
- **Soil sampling :** 1st – before grazing, 2nd - after grazing and 3rd – summer in corn field followed by grazing at 0-5 and 5-15 cm depths.
- **Measured Parameters :** soil microbial biomass carbon & nitrogen (MBC and MBN), soil urease enzyme, soil β-glucosidase, soil penetration resistance(SPR), soil carbon & nitrogen fractions (C & N fractions).
- **Statistical analysis :** SAS 9.4 software using ANOVA with α = 0.05.

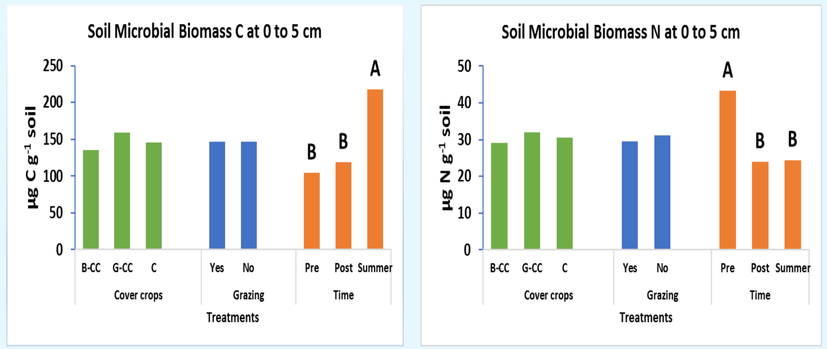
Results

- **Table 1.** Interaction among cover crops *(CC)*, grazing *(G)* and time *(T)* factors (*fixed effects P>F*). No significant interaction were observed in all parameter

	Fixed Effects *(P>F)*	
Interactions	MBC, MBN, Soil labile C & N fractions, BD, SPR, soil Urease and β-glucosidase	
	0-5 cm	5-15 cm
CC × G	NS*	NS
CC × T	NS	NS
G × T	NS	NS
CC × G × T	NS	NS

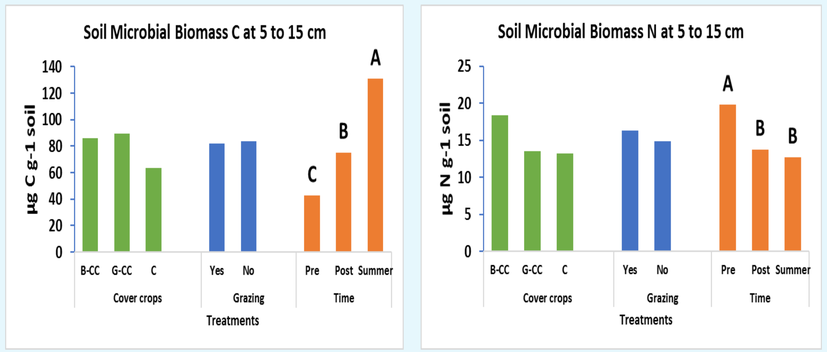
- * NS: Non significant

- **MBC & MBN** (0-5 cm)**:** Time significantly influenced MBC and MBN. Cover crops and grazing had no significant effect **(Fig. 3)**.



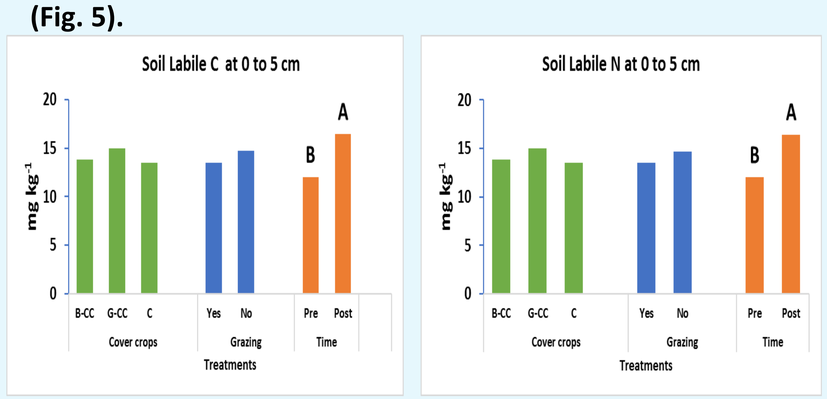
- **Fig. 3.** Microbial Biomass Carbon and Nitrogen as influenced by cover crops under grazed and ungrazed treatments in ICLS system at three different time intervals at 0-5 cm depth. Note: Mean values followed by different lower letters between each treatment (cover crop and grazing) within each depth represent significant differences at P<0.05.

- **MBC & MBN** (5-15 cm): Time significantly impacted MBC and MBN. Cover crops and grazing had no significant effect **(Fig. 4).**



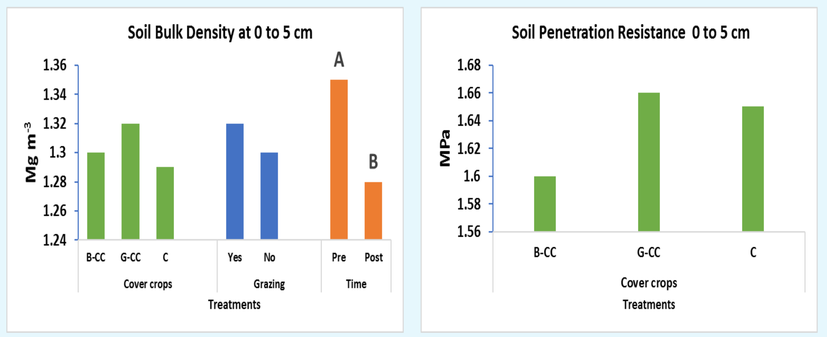
- **Fig. 4.** Microbial Biomass Carbon and Nitrogen as influenced by cover crops under grazed and ungrazed treatments in ICLS system at three different time intervals at 5-15 cm depth.

- **Soil labile C and N** (0-5 cm)**:** Time significantly impacted both labile C & N. Cover crops and grazing had no significant effect **(Fig. 5).**



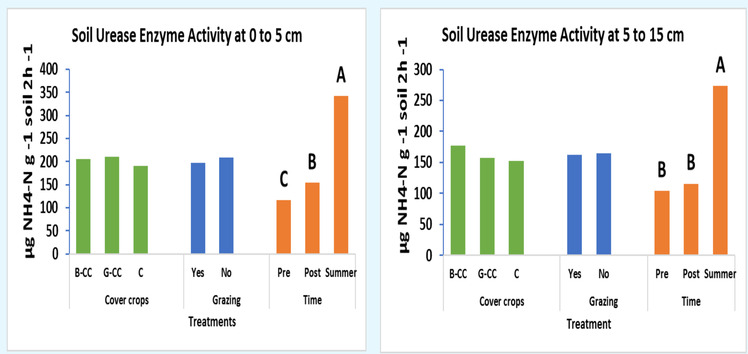
- **Fig. 5.** Soil labile C and N measured as influenced by cover crops under grazed and ungrazed treatments in ICLS system with two different time intervals at 0-5 cm depth.

- **Soil BD & SPR** (0-5 cm)**:** Time significantly impacted soil bulk density. Cover crops had no significant effect on soil penetration resistance and bulk density **(Fig. 6).**



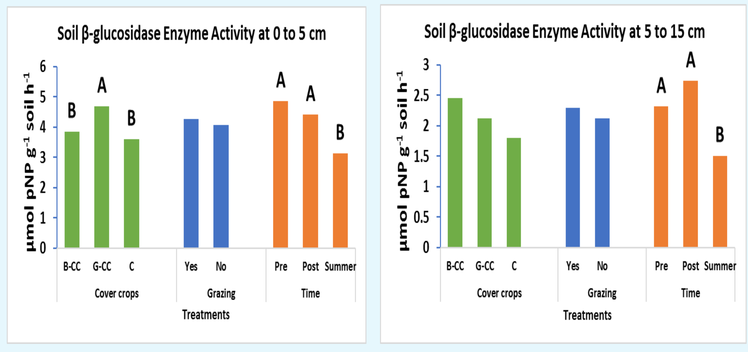
- **Fig. 6.** Soil bulk density and penetration resistance as influenced by cover crops under grazed and ungrazed treatments in ICLS system with two different time intervals at 0-5 cm depth. Note:

- **Soil Urease:** Time significantly impacted soil urease activity at both depths. Cover crops and grazing had no significant effect **(Fig. 7).**



- **Fig. 7.** Soil urease enzyme activity as influenced by cover crops under grazed and ungrazed treatments in ICLS system with three different time intervals at two depths .

- **Soil β-glucosidase:** Time factor had significantly impacted soil β-glucosidase at both depths. Cover crops and grazing had no significant effect **(Fig. 8).**



- **Fig. 8.** Soil β-glucosidase enzyme activity as influenced by cover crops under grazed and ungrazed treatments in ICLS system with three different time intervals at two depths .

Conclusions

- Time factor significantly :
  - — increased soil microbial biomass C, soil urease activity, soil labile C and labile N
  - — decreased soil microbial biomass N, soil β-glucosidase activity.
- Grazing did not significantly impact all parameters including the soil bulk density at 0-5 cm depth.
- Cover crops had no significant effect on all soil parameters except soil β-glucosidase activity.
- ICL system has neutral to positive impacts on soil health parameters.

Future Work

- Accessing the impacts of Integrated Crop-Livestock System on soil :
  - — Physical & hydrological,
  - — Microbial properties i.e. phospholipid-derived fatty acids,
  - — Water quality parameters and
  - — GHGs emissions.

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