



Regional Assessment of Implications of Cattle Grazing and Baling of Corn Residues on Soil Ecosystem Services under Irrigated and Rainfed Conditions

M. Rakkar^a, H. Blanco^a, K. Ulmer^b, J. Cox^b, R. Rasby^b, M. Drewnoski^b, J. MacDonald^b

^aDepartment of Agronomy and Horticulture and ^bDepartment of Animal Sciences, University of Nebraska- Lincoln



Background

- ❖ Cattle grazing and baling of corn residue may impact soil ecosystem services such as soil erodibility, C stocks, fertility, water conservation, and crop production, among others.
- ❖ Cattle can cause soil compaction by exerting high pressure (~200 kPa) on soil (Clark *et al.*, 2004).
- ❖ A recent survey in Nebraska revealed that one of the main concerns from producers who did not allow residue grazing was compaction (Jordan *et al.*, 2016).
- ❖ Similarly, residue baling could increase soil erodibility in both rainfed and irrigated soils (Blanco-Canqui *et al.*, 2016).
- ❖ Limited research information is available on the magnitude of impact of cattle grazing and baling on soil ecosystem services across soils with different precipitation and management scenarios.

Objective

To better understand how crop residue baling and grazing under integrated crop-livestock systems impact relevant soil ecosystem services.

Material and Methods

- ❖ Six on-farm sites were used for this project (Fig. 1).

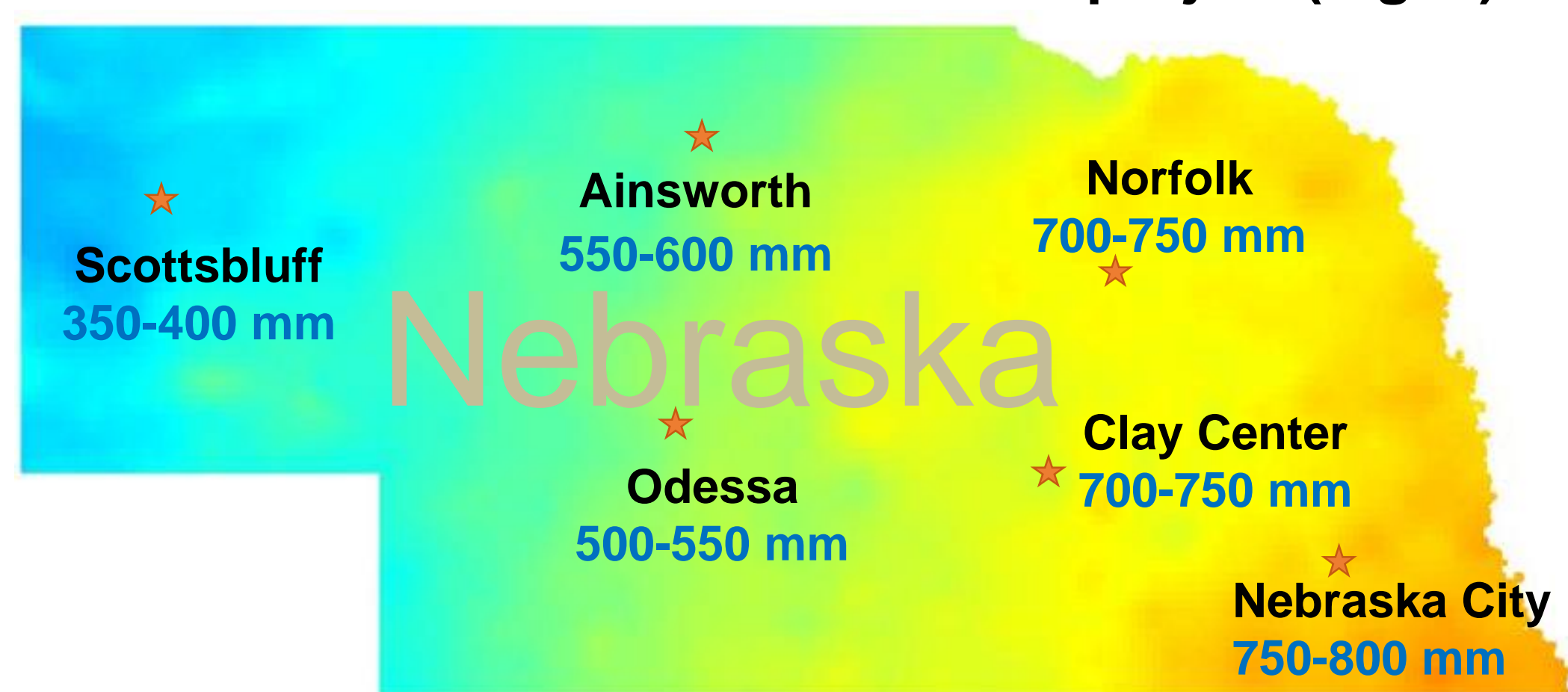


Fig. 1. Six sites distributed across the precipitation gradient in Nebraska with different soils and management systems.

Table 1. Description of study sites.

Study site	Soil texture	Slope (%)	Tillage system	Irrigation	Crop rotation
Nebraska City	Silty clay loam	2 to 6	No-till	Rainfed	Corn-soybean
Norfolk	Loam	0 to 2	No-till	Sprinkler	Continuous corn
Ainsworth	Loam	0 to 2	Disk	Sprinkler	Continuous corn
Clay Center	Silt loam	0 to 2	Strip-till	Sprinkler	Continuous corn
Odessa	Silt loam	1 to 3	No-till	Sub-irrigation	Continuous corn
Scottsbluff	Sandy loam	1 to 3	No-till	Sprinkler	Corn-sugar beet

- ❖ Three treatments were studied for 2 yr including corn residue baling (~56%) each fall after corn harvest, grazing (3 to 6 AUM ha⁻¹), and control (Fig. 2)
- ❖ Cone index and bulk density were measured to assess soil compaction.
- ❖ Residue cover impact on daytime soil temperature was measured in spring.
- ❖ Soil was sampled in spring 2015 and 2016 before planting to determine wind erodibility and soil fertility.
- ❖ Corn yield was determined in fall 2014 and 2015.

Results and Discussion



Fig. 2. Residue cover for each treatment at the Clay Center site.

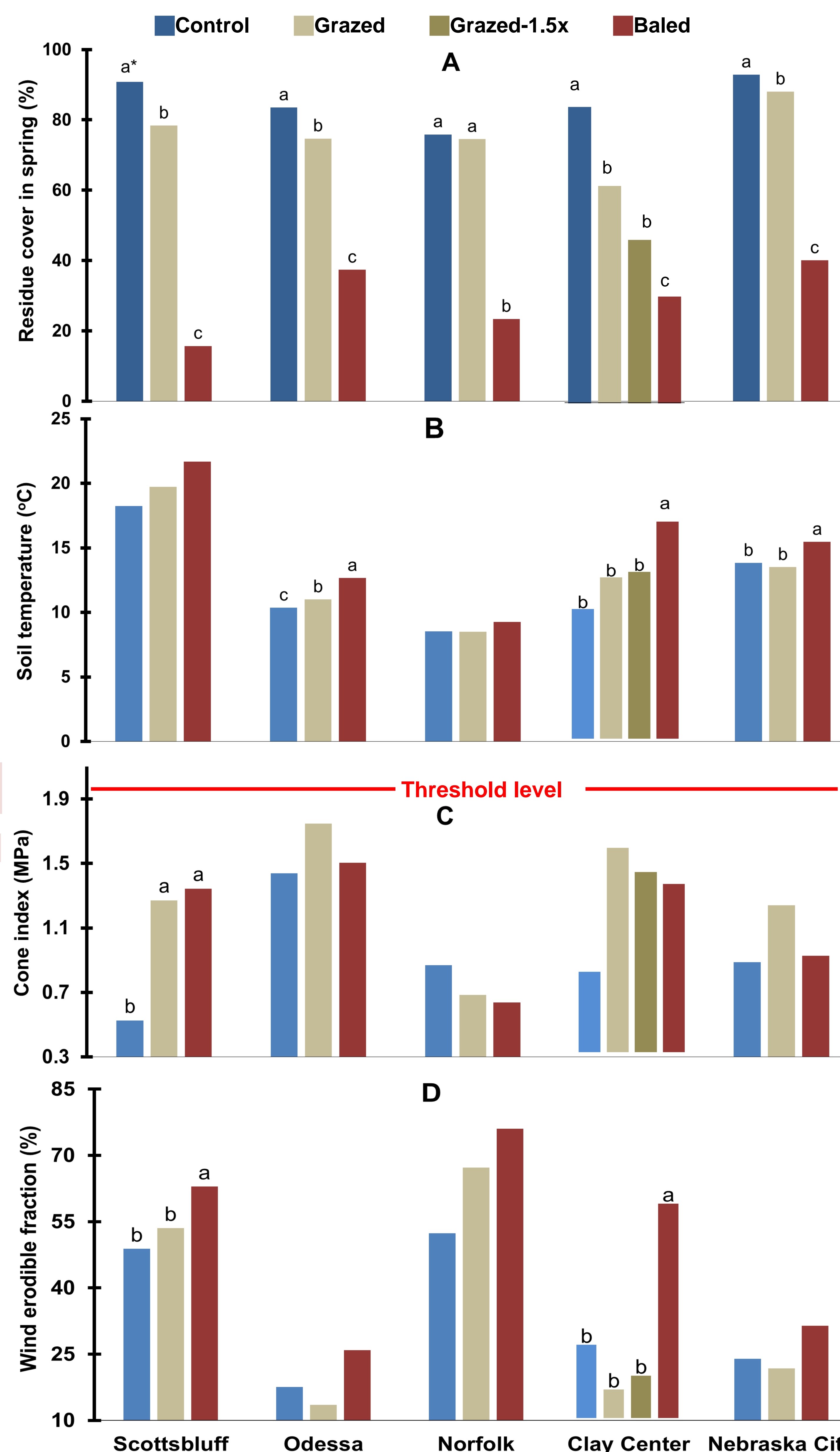


Fig. 3. Impact of corn residue grazing and baling on A) residue cover B) soil temperature C) cone index D) wind erodible fraction. Bars with different letters within the same site are significantly different at a *P* value of 0.05.

- ❖ Baling reduced residue amount from 10.3 Mg ha⁻¹ (control) to 3.64 Mg ha⁻¹, while grazing reduced residue amount to 8.78 Mg ha⁻¹. Residue cover was 35 % for baling and 85 % for grazing (Fig. 3A).
- ❖ Baling increased soil temperature by ~ 3°C in spring, but grazing, in general, had no effect (Fig. 3B).
- ❖ Baling and grazing increased cone index only in one of the six sites (Fig. 3C). The level of increase at this site was, however, below the threshold level of ~2 MPa to negatively affect crop yield.
- ❖ Baling increased the risk of wind erosion at two sites, while grazing had no effect at any of the study sites (Fig. 3D).
- ❖ Baling and grazing did not affect soil C stocks, fertility, and subsequent crop yields.
- ❖ Overall, corn residue grazing did not negatively affect any of the studied soil ecosystem services.
- ❖ Results show that residue baling has greater effect on wind erosion risk and soil water content because it removes larger amount of residue than grazing.
- ❖ Further (> 2 yr) monitoring of residue removal effects is needed for a better understanding of changes in soil ecosystem services.

Summary and Conclusion

Effect on:	Grazing	Baling
Soil compaction	May or may not increase (If increased, below threshold to affect yield)	May or may not increase (If increased, below threshold to affect yield)
Residue cover	Reduces (<20 %)	Reduces (>50 %)
Wind erosion	No effect	May or may not increase
Temperature	No effect	Increases (~3°C)
Soil water content	No effect	Reduces (~20%)
Soil fertility	No effect	No effect
Crop yield	No effect	No effect

- ❖ Our short-term data suggest that corn residue grazing can be a potential opportunity to provide additional livestock feed without negatively impacting soil ecosystem services.
- ❖ However, corn residue baling could negatively affect some soil ecosystem services such as increased erosion risks and reduced soil water content due to the high amount (>50 %) of residue removal compared with grazing (<20 %).

Acknowledgement

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