

Cover Crops for Expanded Uses: Impacts on Soil Health and Crop Yields

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Session Goals

- Discuss whether or not cover crops produce biomass sufficient for expanded uses.
- Describe how to improve cover crop biomass production.
- Know how using cover crops for other uses can impact soil health and crop yields.

Definition of Soil Health

“Soil health, also referred to as soil quality, is defined as the continued capacity of soil to **function** as a **vital living ecosystem** that **sustains** plants, animals, and humans. This definition speaks to the importance of managing soils so they are sustainable for future generations. To do this, we need to remember that soil contains living organisms that when provided the basic necessities of life - food, shelter, and water - perform functions required to produce food and fiber.”

-NRCS

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N EXTENSION

Expanded Uses of Cover Crops

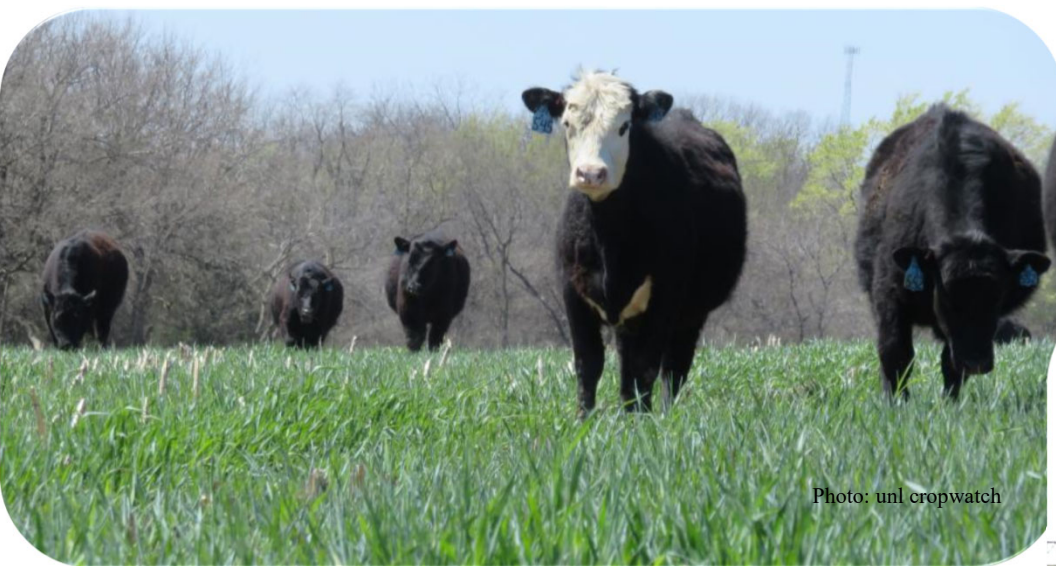


Photo: unl cropwatch

Grazing

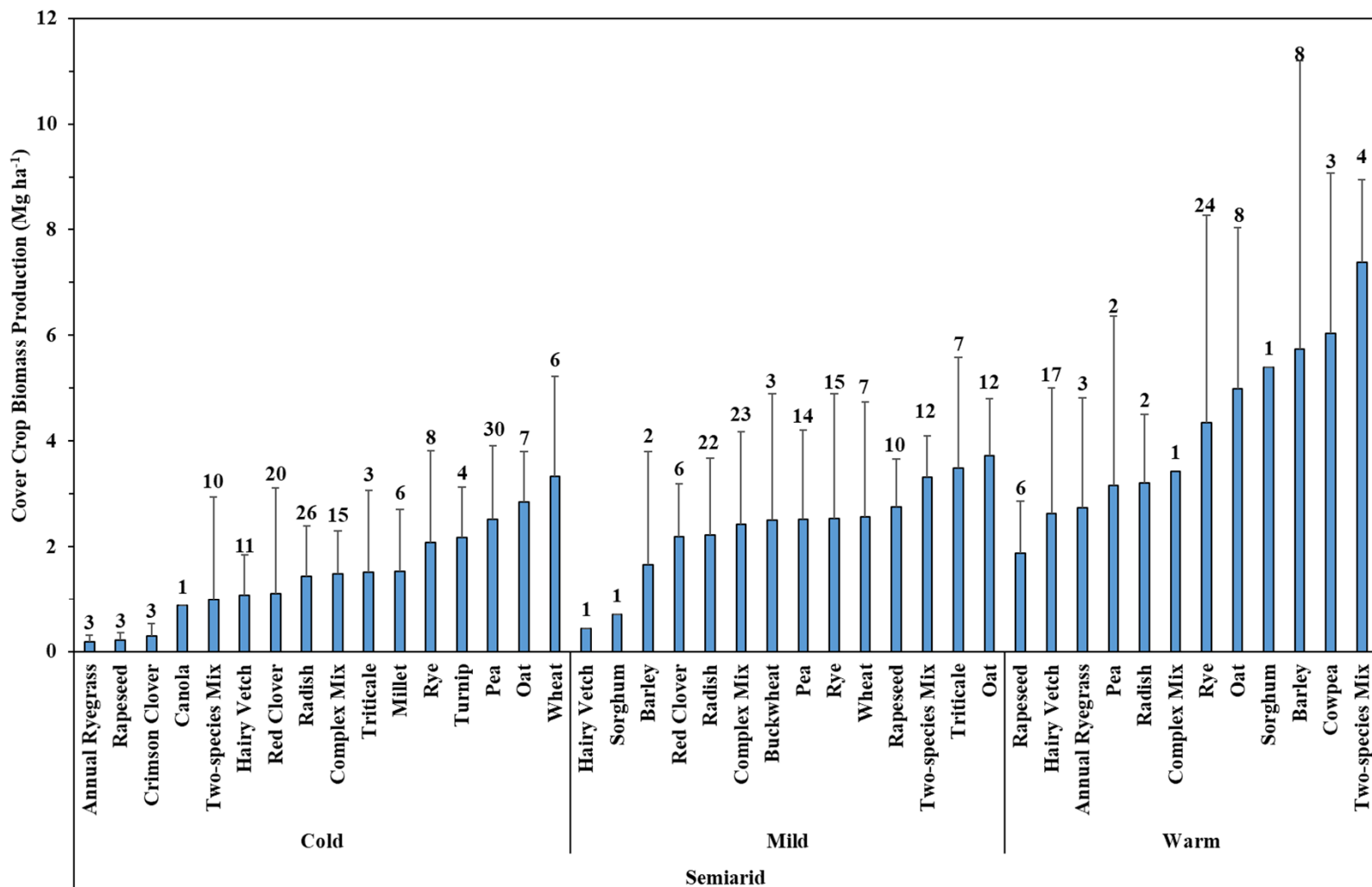
Haying



Key Question #1

Do cover crops produce enough biomass for expanded uses?

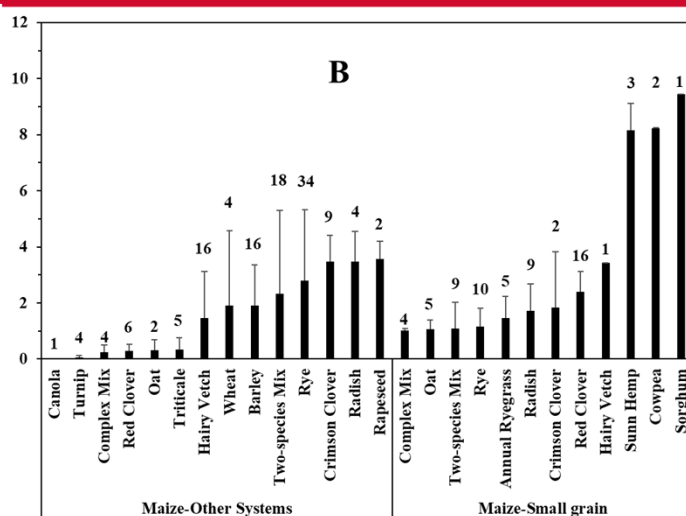
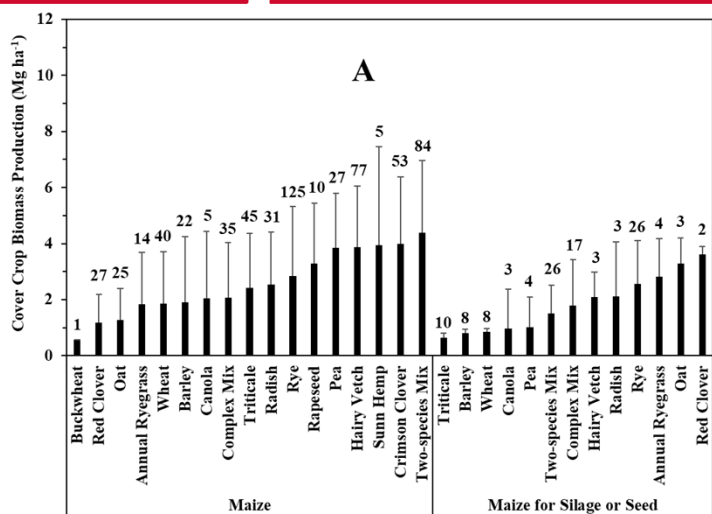
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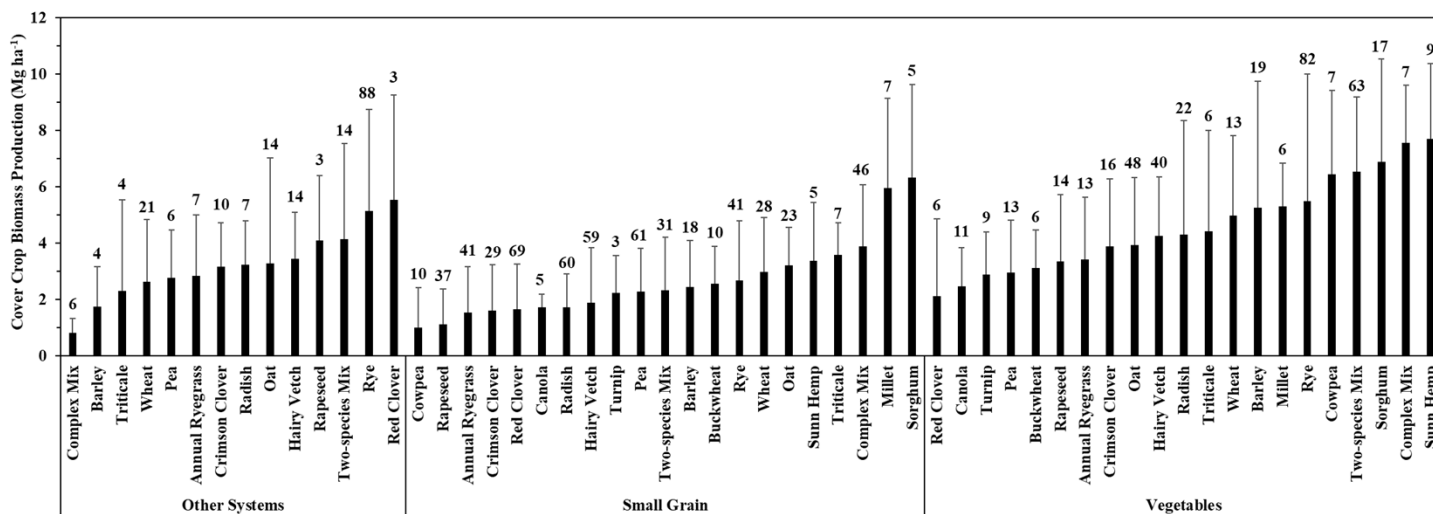
Key Question #2

In what situations can I produce enough cover crop biomass for expanded uses?

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- Considerations:
- 1) Cover Crop Species
 - 2) Cropping System
 - 3) Termination Timing



Key Question #3

How much biomass do we get from cover crops in western Nebraska and what are the impacts to crop yields?

Cover Crop Use in Western Nebraska

- **Four sites across 2 years: Gothenburg, North Platte, Sidney, Grant**
- **Treatments: Winter sensitive cover crop mix, Winter hardy cover crop mix terminated early or late**
- **Cropping System: Winter wheat-corn**

Data from: Rosa, 2020

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Cover Crop Biomass and Impacts to Soil Water and Crop Yield in Nebraska

Treatment	Cover Crop Biomass Production	Organic Matter	Water Content	Yield
	(ton ac ⁻¹)	(%)	(m ³ m ⁻³)	(ton ac ⁻¹)
No Cover Crop		2.3ab	0.266a	4.0a
Winter-sensitive	0.64	2.1b	0.264a	3.7b
Winter-hardy Early-termination	0.44	2.3ab	0.263a	3.7b
Winter-hardy Late-termination	1.42	2.4a	0.255b	3.3c

Data from: Rosa, 2020

Cover Crop Use in Western Nebraska

- **Two sites across 2 years, but focusing on Sidney, NE**
- **Treatments: Fallow vs Varying Cover crop types**
- **Cropping System: Proso millet-winter wheat**

**Data from:
Nielsen et al.,
2015 and
2016**

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Treatment	Cover Crop Biomass Production (ton ac ⁻¹)	Water Available at Planting (in)	Yield (ton ac ⁻¹)
<u>Dryland 2012-13</u>			
Fallow		8.19a	1.47a
Cover Crop	0.61-1.14	6.22b	1.21b
<u>Irrigated 2012-13</u>			
Fallow		10.35a	1.86a
Cover Crop	1.46-1.96	8.54b	1.55b
<u>Dryland 2013-14</u>			
Fallow		10.07a	NS
Cover Crop	1.34-2.23	9.37b	
<u>Irrigated 2013-14</u>			
Fallow		10.55a	NS
Cover Crop	1.30-2.49	9.25b	

**Data from:
Nielsen et al.,
2015 and
2016**

Key Question #4

How does grazing or haying cover crops affect soil health parameters and crop yields?

What do we know about grazing cover crops?

Location	Cover Crop	Findings	Reference
Georgia (2.5 and 7 yr)	Crimson clover, rye, ryegrass in no-till and conventional till	<ul style="list-style-type: none">• Minimal to no effects on soil physical properties (tendency to increase penetration resistance and reduce water content)• Increased soil microbial biomass C in no-till but not conventional till• No effect on soil C	Franzluebbers and Stuedemann (2007, 2008) Franzluebbers and Stuedemann (2015)
Georgia (4 yr)	Rye in no-till	<ul style="list-style-type: none">• Reduced cotton yields in 1 of 4 yr due to soil compaction	Schomberg et al. (2014)
Ohio (2 yr)	Ryegrass and winter rye and oat mix in no-till	<ul style="list-style-type: none">• Increased penetration resistance by 7-15% in yr 1, but not yr 2• No effect on corn silage yield	Fae et al. (2009)

Case Studies of Cover Crop Grazing in Nebraska

Tecumseh

- **Treatments:** Grazed and ungrazed cover crop and no cover crop control
- **1.8 cows per acre grazed winter rye and cover crop mixes (oats, rape, turnips, and radishes) from about October 1 to mid December**
- **Cropping System:** Rainfed no-till corn silage-soybean-winter wheat

North Platte

- **Treatments:** Grazed and ungrazed cover crop and no cover crop control
- **Two cow-calf pairs per acre grazed winter rye cover crop from about March 20 to May 20 each year (2016, 2017, and 2018).**
- **Cropping system:** Sprinkler irrigated strip-till continuous corn silage

Case Studies of Cover Crop Grazing in Nebraska

Data from Blanco et al.

Site	Treatment	CC Biomass Production	Penetration Resistance	Water Content at Planting	Aggregate Size	Soil Organic Matter	Yield
		(ton ac ⁻¹)	(Psi)	(%)	(in)	(%)	(ton ac ⁻¹)
Rainfed, Tecumseh	No CC		345a				NS across soybean-corn-wheat
	CC	2.12	189b	NS	NS	NS	
Irrigated, North Platte	CC Grazed		191b				NS 3 yr of corn silage
	No CC			32a			
	CC	3.60	NS	35a	NS	NS	
	CC Grazed			24b			

What do we know about haying cover crops?



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Agronomy Journal

REVIEW

Harvesting cover crops for biofuel and livestock production: Another ecosystem service?

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Abstract

Harvesting cover crops (CCs) for livestock and biofuel production can be an important ecosystem service from CCs, but this potential service has not been widely discussed. We reviewed the potential use of CCs for livestock or biofuel production, impacts of CC harvesting on soils and crops, the amount of harvestable CC biomass, and strategies to enhance CC biomass production. We searched literature in Web of Science using terms such as “cover crops,” “harvesting,” “soil properties,” and “crop yield,” among others, and found about 30 papers. The literature indicates that CC harvesting does not generally affect soil properties, crop yields, and weed suppression, although the studies are relatively few. Leaving 7.5–10 cm of CC stubble after harvest could maintain soil ecosystem services. Cover crops produce $3.37 \pm 2.96 \text{ Mg ha}^{-1}$ (mean \pm SD) of aboveground biomass and $1.33 \pm 0.98 \text{ Mg ha}^{-1}$ of belowground (root) biomass. Root biomass input, representing about 30% of the total CC biomass production, could be critical to the maintenance of soil services after CC harvest. The amount of harvestable biomass while maintaining soil services ranges from 1–3 Mg ha^{-1} in semiarid regions and from 1–6 Mg ha^{-1} in humid regions for high-biomass-producing CCs. Strategies to increase CC biomass production include planting CCs early and terminating late, adapting cropping systems by using earlier-maturity group varieties, and using flexible cropping systems. Overall, CC harvesting appears feasible, but additional research on CC management and harvesting effects on ecosystem services is needed before harvesting CCs at large scales.

Case Study of Cover Crop Haying from Sidney

- **Treatments**
 - **Harvested and unharvested rye and triticale cover crop**
 - **No cover crop control**
- **Cropping System: Rainfed no-till winter wheat-cover crop-corn-cover crop-winter wheat**



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Case Study from Sidney, Nebraska

Treatment	CC Biomass Production (ton ac ⁻¹)	Penetration Resistance (Psi)	Aggregate Stability (%)	Particulate/Labile Organic Matter (%)	Yield (ton ac ⁻¹)
No CC		207a	38.3	1.04	NS for corn and winter wheat in 2018 and 2020
Unharvested Rye	0.43	165b	57.5	1.54	
Harvested Rye		103d	52.7	1.14	
Unharvested Triticale	0.42	186b	49.3	1.30	
Harvested Triticale		131c	44.3	1.35	



Take Home Points

- Cover crops can be used as more than just a cover crop: grazing and haying
- Cover crop biomass production can be sufficient for other uses if they are in the right cropping system, terminated at the right time, and right species
- Cover crop grazing has few impacts on soil health parameters – including compaction
- Likewise, cover crop haying may have no impacts on soil health and crop yields in the short-term

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Questions