

# **Cover Crop Management for Soil Health in Nebraska**

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## Session Goals

Describe how to cover crop management affects soil health

## 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

- Color
- Wet and dry aggregate stability
- Bulk Density
- Penetration resistance
- Crust properties
- Infiltration
- Hydraulic conductivity
- Water content at different suctions
- Soil temperature
- Thermal conductivity
- Soil gas concentrations
- Runoff and sediment loss rates
- Others

## SOIL PHYSICAL PROPERTIES

## SOIL CHEMICAL PROPERTIES

- pH
- Cation exchange capacity
- Base saturation
- Organic matter
- Organic C
- Soluble salts
- Nutrients (N, P, K, Ca, Mg, S, Fe, Zn, and others)

## Soil Health

## SOIL BIOLOGICAL PROPERTIES

- Microbial biomass C
- Microbial biomass N
- Fluxes of CO<sub>2</sub>, N<sub>2</sub>O, etc.
- Earthworm counts
- Arbuscular mycorrhizal fungi
- Others

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## To Further Harness Benefits to Ecosystem Services

Ordinary, Business as Usual Practices

Cover Crops Planted in Fall after Harvest



Improved Management Practices

Terminate Late



Plant Early before Harvest



After Short-Season Crop



United States Department of Agriculture  
National Institute of Food and Agriculture

## Four-Year Planting Early into Standing Crops

- ▶ Three sites in Nebraska: Concord, Mead, Clay Center
- ▶ Preharvest (Sept) and postharvest (Late Oct) planted rye or mix cover crops
- ▶ Soil properties assessed after four cover crop cycles



Soil Service	Planting Date Effect
Cone Index (Compaction)	Reduced at 2/3 sites
Mean Weight Diameter Water Stable Aggregates (Structural Quality)	Increased at 1/3 sites
Labile or Particulate Organic Matter	Increased at 1/3 sites
Soil Organic C	NS
Total Soil N	NS

## Four-Year Planting Early into Soybean Crops

- ▶ Three sites in Nebraska: Concord, Mead, Clay Center
- ▶ Preharvest (Sept) and postharvest (Late Oct) cover crops
- ▶ Soil properties assessed after four years

**Early planting generally reduced compaction, but had minimal effects on other soil properties due to low cover crop ton/ac**



	Planting Date Effect
Soil Compaction	Reduced at 2/3 sites
Water Weight Diameter	Increased at 1/3 sites
Water Stable Aggregates (Structural Quality)	
Labile or Particulate Organic Matter	Increased at 1/3 sites
Soil Organic C	NS
Total Soil N	NS

## Six-Year Terminating CCs Late



- ▶ Two sites: Rainfed and Irrigated, focus on Irrigated due to higher CC biomass production
- ▶ No-till continuous corn for 6 yr
- ▶ Early termination 2-3 weeks prior to planting
- ▶ Late termination at planting

### CC Biomass Yield

Early: 0.04-0.27 ton/ac

Late: 0.61 to 2.05 ton/ac





## Six-Year Terminating CCs Late

Treatment	Penetration Resistance	Aggregate Size	Organic Matter	Water Infiltration	Plant Available Water	Corn Yield
		(mm)	(%)			
No CC		1.18b	4.1b			
Early-Terminated CC	NS	1.13b	4.1b	NS	NS	NS 4/6 years
Late-Terminated CC		1.40a	46a			



## Six-Year Terminating CCs Late

Treatment	Penetration Resistance	Aggregate Size	Organic Matter	Available Water	Corn Yield
No CC					
Early-Term CC			4.1b	NS	NS
Late-Terminated CC		1.40a	4.6a		4/6 years

**Terminating late or at planting increased organic matter and soil aggregation compared to traditional, business as usual termination (2-3 weeks before planting).**

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## Targeting Sites that Need Cover Crops Results after 4 Years



Site	Treatment	CC Biomass Yield (ton ac <sup>-1</sup> )	Aggregate Size	Organic Matter	Nitrate Concentration	Corn and Soybean Yield
Bruno (Sloping)	No CC		NS	NS	Generally NS	NS
	Pre-harvest Planted CC	0.20-1.37				
	Post-harvest Planted CC	0.01-1.16				
Norfolk (Sandy)	No CC		NS	NS	Generally NS	1/4 yr corn yield decreased with CCs
	Pre-harvest Planted CC	0.12-0.58				
	Post-harvest Planted CC	0.06-0.24				

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## Targeting Sites that Need Cover Crops Results after 4 Years



Site	Treatment	CC Biomass Yield (ton ac <sup>-1</sup> )	Aggregate Size	C	and Soybean Yield
Bruno (Sloping)	No CC				Generally NS NS
	Pre-harvest Planted CC				
Norfolk (Sandy)			NS	NS	Generally NS 1/4 yr corn yield decreased with CCs
	Pre-harvest Planted CC	0.12-0.58			
	Post-harvest Planted CC	0.06-0.24			

**Early planting about 1 month prior to harvest at sloping and sandy sites had minimal effects on soil health and crop yields after 4 yr.**

## Cover Crop following Corn Silage or Winter Wheat

### Tecumseh

- **Treatments:** cover crop (oat-turnip-radish) and no cover crop control
- **Cropping System:** Rainfed no-till corn silage-soybean-winter wheat

### North Platte

- **Treatments:** Rye and no cover crop control
- **Cropping system:** Sprinkler irrigated strip-till continuous corn silage

## Cover Crop following Corn Silage or Winter Wheat

Data from Blanco et al.

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

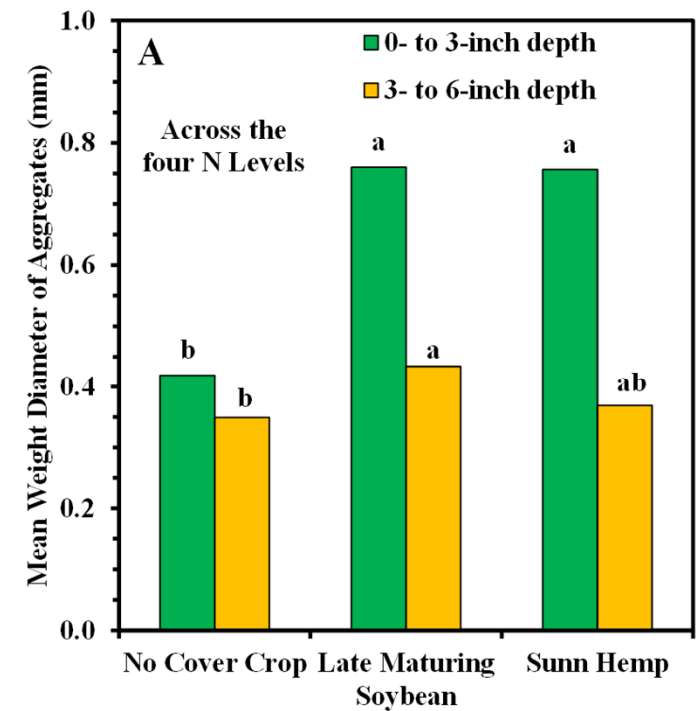
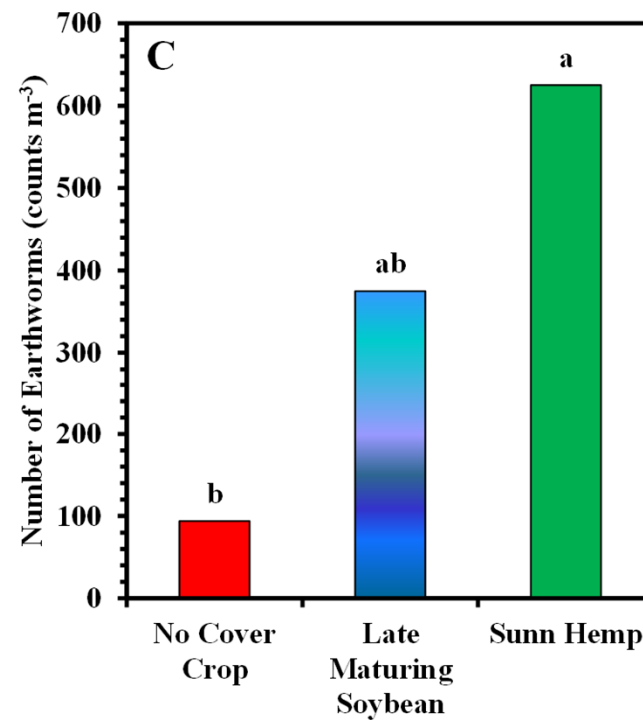
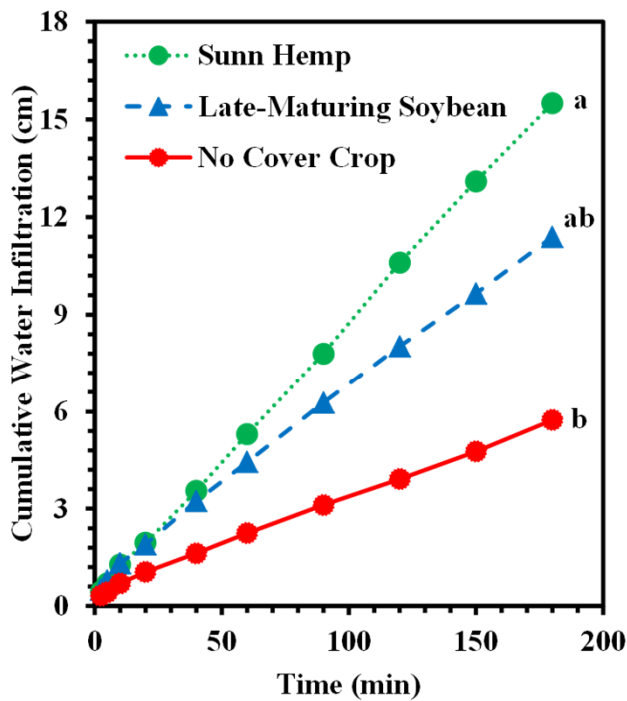
## Planting After Winter Wheat Short-Term vs Long-Term

- Short-Term near Eagle, NE:
- 3 yr - Winter wheat-corn-soybean
  - No effects on soil properties after 3 yr (one crop cycle)
  - Even with  $>4 \text{ Mg ha}^{-1}$  biomass in with sorghum-sudangrass and sunn hemp
- Long-Term in Kansas
- 15 yr in no-till winter wheat-sorghum Late-maturing Soybean and Sunn Hemp CCs after wheat
- Biomass:
  - Late-maturing Soybean –  $5.3 \text{ Mg ha}^{-1}$
  - Sunn Hemp –  $7.0 \text{ Mg ha}^{-1}$

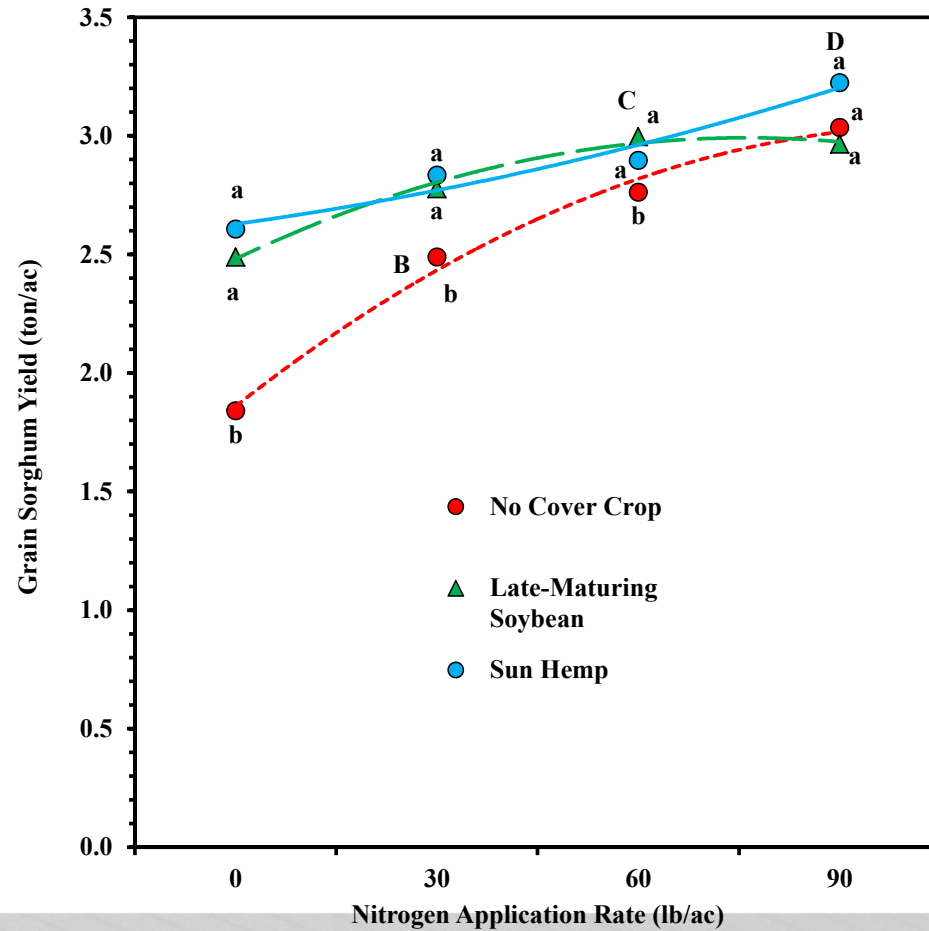
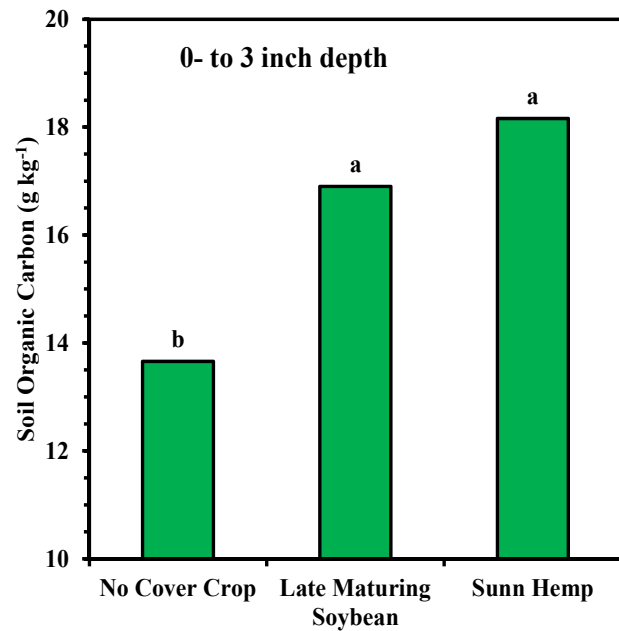


Figure 1. Cover crop experiment at the former Harvey County Experimental Field in Hesston (Photo by Mark M. Claassen, K-State Research and Extension)

## Data from Blanco et al. 2011

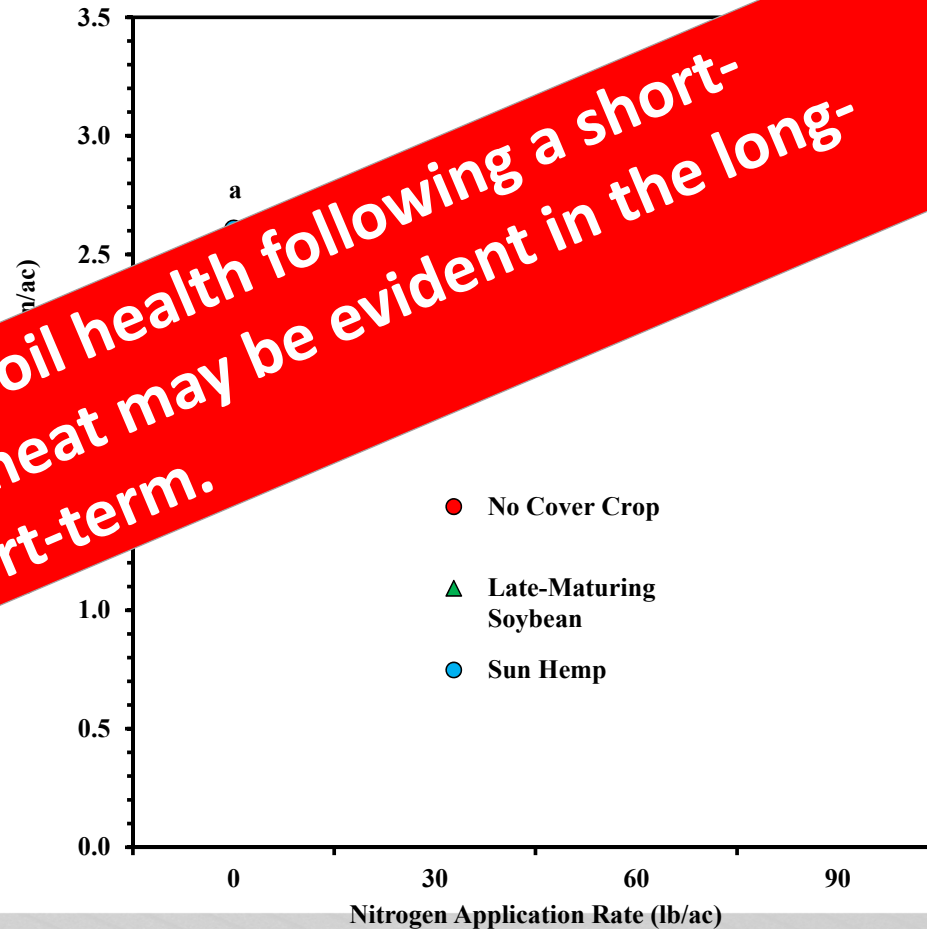
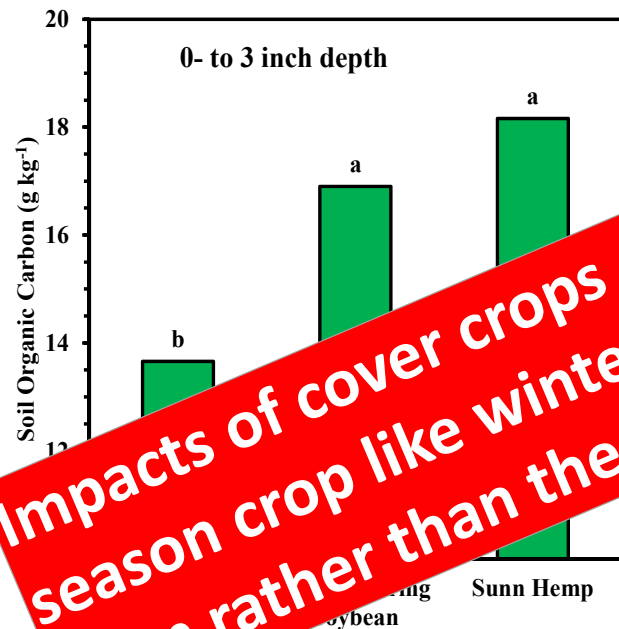






Data from Blanco et al. 2011

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Impacts of cover crops on soil health following a short-season crop like winter wheat may be evident in the long-term rather than the short-term.

Data from Blanco et al. 2011

## Take Home Points

- **Early planting of cover crops in corn-soybean generally reduced compaction but had minimal effects on other soil health parameters due to low biomass production.**
- **Terminating late or at planting increased organic matter and soil aggregation compared to traditional termination time after 6 yr.**
- **Early planting about one month prior to harvest in sloping and sandy sites had minimal effects on soil health and crop yields in the short-term.**
- **Impacts of cover crops on soil health following a short-season crop like winter wheat may be evident in the long-term rather than the short-term.**

## Questions