

# Enhancing Water and Nitrogen Use Efficiency in Soybean-Corn Rotations with Winter Cover Crops

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## Introduction

- Soybean [*Glycine max* (L.) Merr.] and corn (*Zea mays* L.) are the dominant crops in the midwestern United States
- Highly intensive agricultural systems require changes in practices to enhance the efficiency of resources use
- Cover crops have the potential to enhance water and nitrogen use in current rotation systems
- This research studies winter cover crops water and nitrogen use and their impact on major crop production

## Materials and Methods

### Location

- Southwest Research and Outreach Center Lamberton Minnesota



### Experiment

- A 2-yr soybean-corn rotation experiment through integration of winter annual cover crops
- Winter cover crops included camelina (*Camelina sativa* L. Crantz), field pennycress (*Thlaspi arvense* L.), and cereal rye (*Secale cereale* L.) in a RCBD with four reps
- Cover crops were interseeded into soybean at R7-R8 stage and into corn at the R6-R7 stage in 2015. In 2016, cover crops were interseeded at R6 and R8 in soybean and corn respectively
- Cover crops were terminated 7-10 days before planting of major crops

### Data Obtained

- Spring and fall soil samples, soil moisture readings down to 1m with PR2 (Delta-T Devices) soil moisture probes
- Cover crop biomass, percent coverage, agronomic crop data, phenology, crop biomass, crop CNS tissue tests, yield data
- Water use from water balance and ETo x kc
- Nitrogen use as total aboveground biomass x N in tissue
- Water and nitrogen use and efficiencies as (grain yield)/(water used) and (grain yield)/(N used), respectively

### Data Analysis

- Analysis of variance and regression and correlation analyses using SAS.

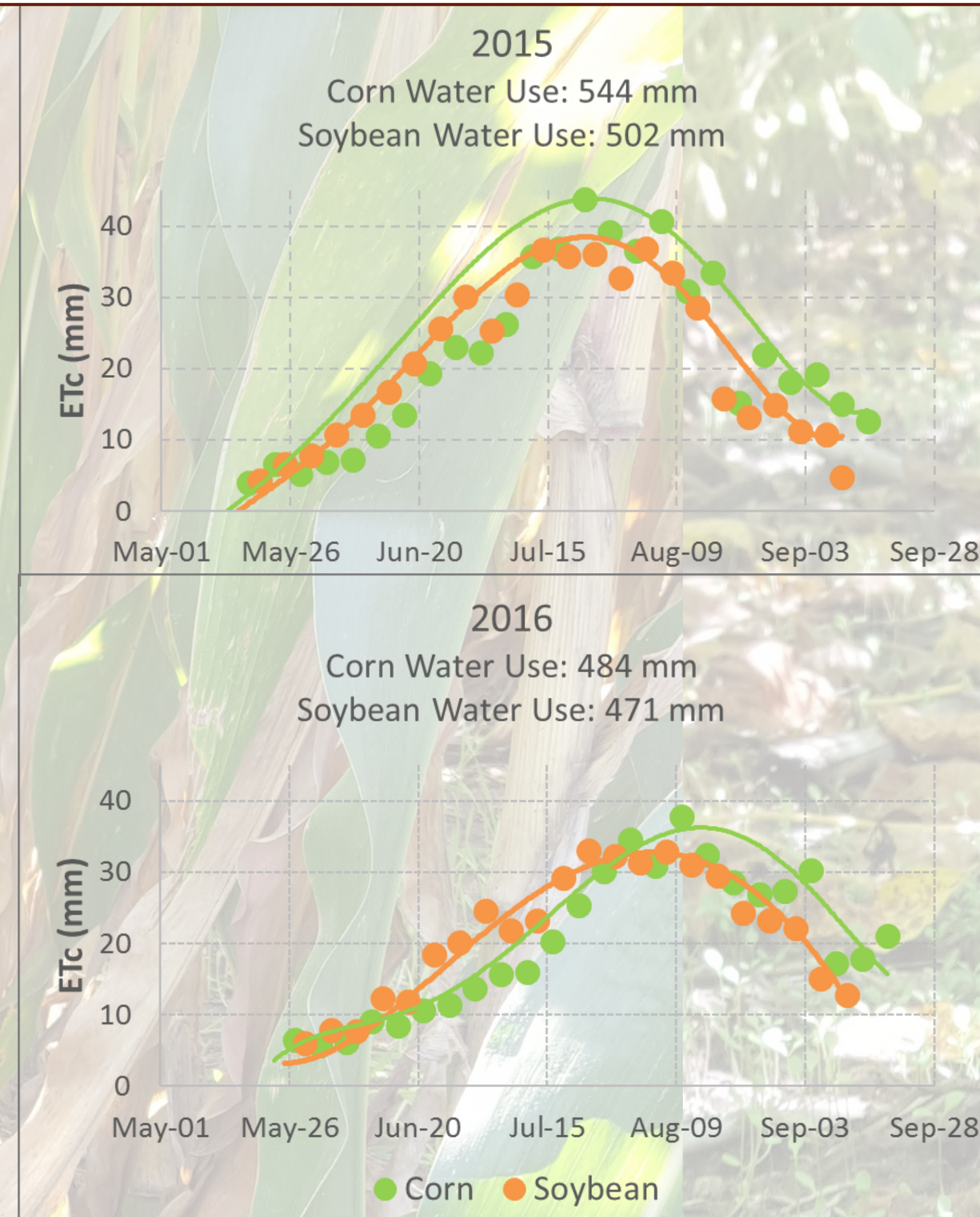
## Objectives

- Determine the water and nitrogen use of crops and cover crops
- Determine the water and nitrogen use efficiency of major crops and cover crops

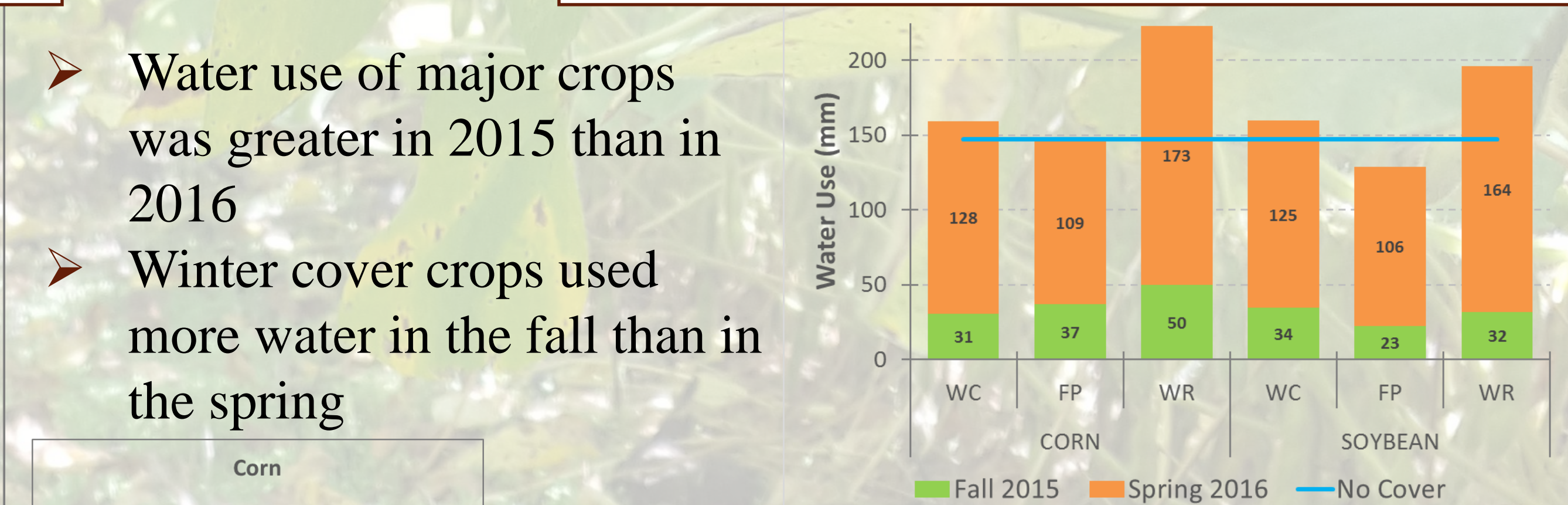
## Results

- Water and nitrogen use of soybean, corn and cover crops were evaluated for 2015 and 2016

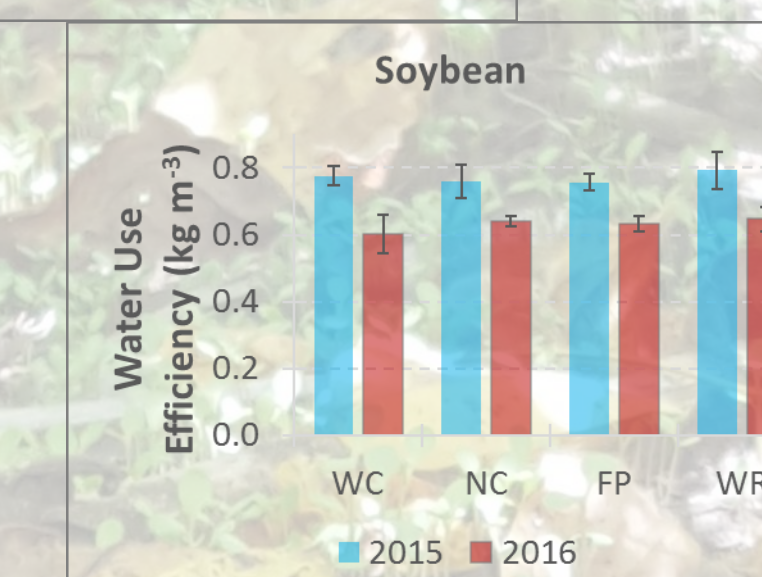
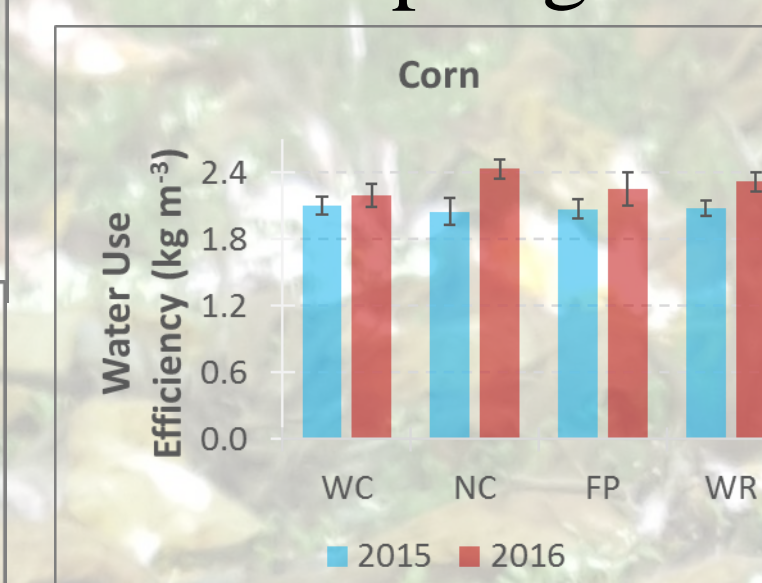
**Fig. 1 - Water use of major crops.** University of Minnesota Southwest Research and Outreach Center, Lamberton, MN



**Fig. 2 - Water use of cover crops.** University of Minnesota Southwest Research and Outreach Center, Lamberton, MN



- Water use of major crops was greater in 2015 than in 2016
- Winter cover crops used more water in the fall than in the spring



- Water use pattern of cover crops was winter rye > winter camelina > field pennycress.

**Fig. 3 - Water use efficiency of major crops.** University of Minnesota Southwest Research and Outreach Center, Lamberton, MN

- Among years, corn WUE varied less than WUE of soybean
- Yield of corn: 2015 no differences; 2016 significant differences among cover crops

**Fig. 4 - Treatment effects on main crop yield and nitrogen uptake among different treatments in 2015 and 2016.** University of Minnesota Southwest Research and Outreach Center, Lamberton, MN

Year	Cover Crop	Corn			Soybean		
		Yield (t ha <sup>-1</sup> )	N uptake (kg ha <sup>-1</sup> )	NUE (kg Grain ha <sup>-1</sup> kg <sup>-1</sup> )	Yield (t ha <sup>-1</sup> )	N uptake (kg ha <sup>-1</sup> )	NUE (kg Grain ha <sup>-1</sup> kg <sup>-1</sup> )
2015	Field pennycress	13.3a (0.5)	274a (22.2)	45.3a (2.0)	4.4a (0.1)	273a (41.1)	14.5a (0.7)
	Winter camelina	13.5a (0.5)	284a (28.5)	43.6a (3.3)	4.5a (0.2)	291a (34.6)	13.7a (2.1)
	Winter rye	13.4a (0.4)	278a (19.2)	43.8a (1.2)	4.6a (0.3)	276a (39.4)	14.1a (2.4)
	No Cover	13.2a (0.8)	291a (23.9)	39.7b (3.1)	4.4a (0.3)	266a (31.8)	15.9a (2.9)
2016	Field pennycress	12.9b (0.9)	199a (21.8)	65.0a (6.8)	3.4a (0.1)	303a (5.4)	11.4a (0.4)
	Winter camelina	12.6b (0.6)	205a (20.2)	61.5a (4.4)	3.3a (0.3)	279a (32.4)	11.8a (0.8)
	Winter rye	13.3ab (0.5)	193a (18.0)	68.9a (4.7)	3.5a (0.2)	296a (16.4)	11.9a (0.9)
	No Cover	13.9a (0.5)	215a (25.8)	65.4a (7.7)	3.5a (0.1)	306a (31.2)	11.5a (1.0)

- Yield of soybean: 2015 and 2016 no differences
- NUE corn: significant differences in 2015, no differences in 2016
- NUE Soybean: no differences

## Conclusions

- Water use of corn and soybean ranged from 484 to 544 mm and from 471 to 502, respectively
- Water use pattern of cover crops was winter rye > winter camelina > field pennycress.

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