

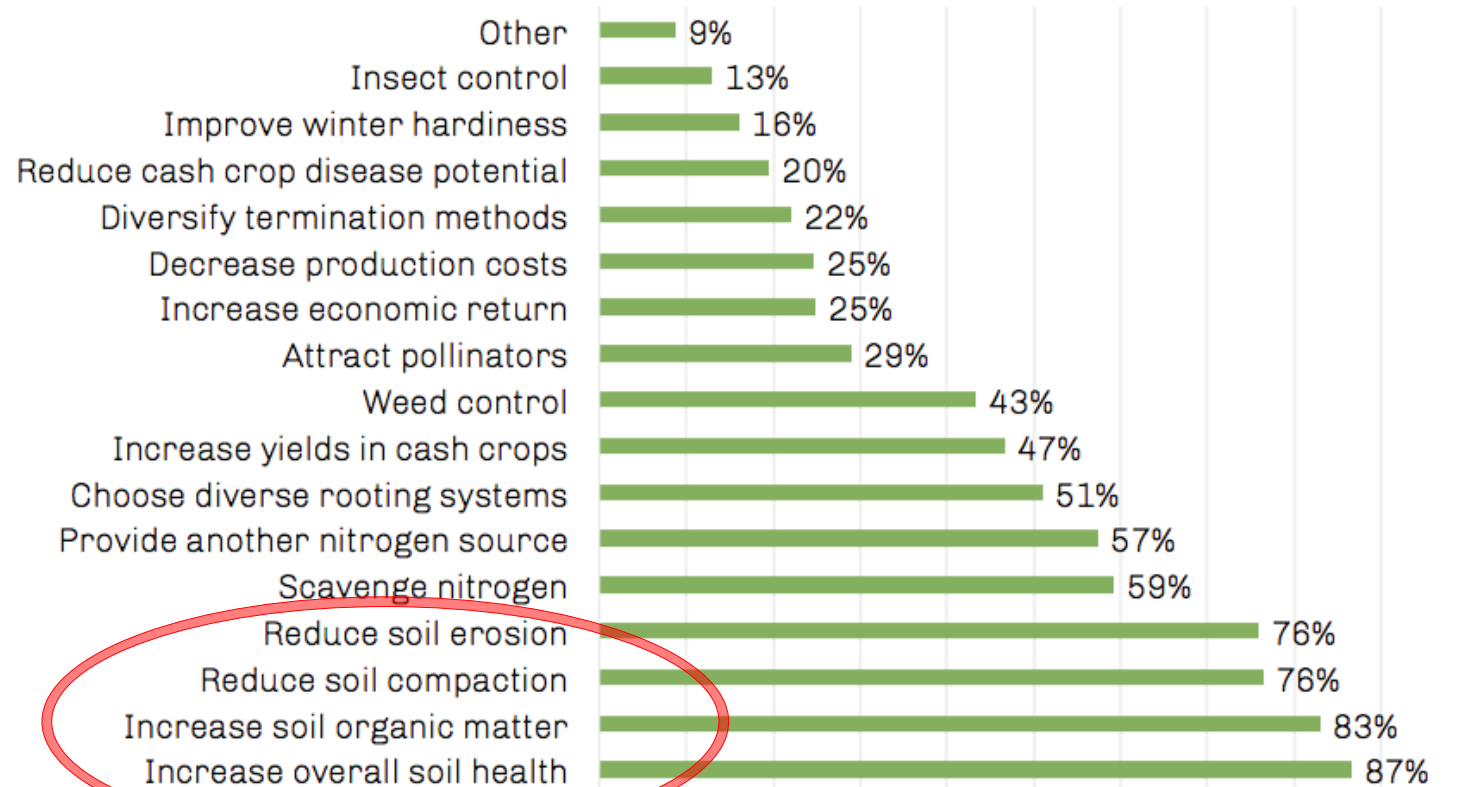
Cover Crop Management for Sugarbeet




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Motivation to use cover crops





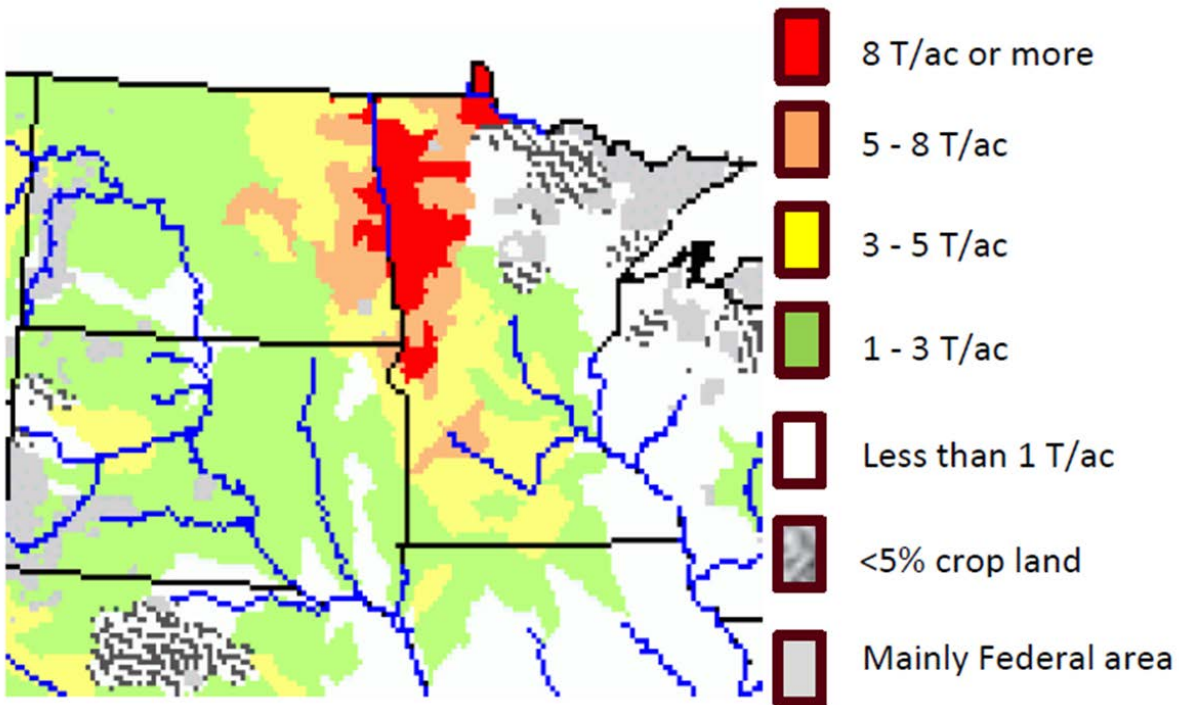
Sugarbeet harvesting hardly leaves any groundcover to protect the soil from wind and water erosion

Soil erosion can reduce your productivity



Table 1: Analysis of total nutrients and windblown soil collected in the field ditch.

	SOIL (T/AC)	TN (LBS./AC)	TP (LBS./AC)	TK (LBS./AC)
DITCH 1	2.6	10.3	3.2	8.0
DITCH 2	2.8	12.1	3.6	8.7
DITCH 3	1.6	8.4	1.9	4.9
DITCH 4	32.6	172.9	46.9	124.4
DITCH 5	5.5	23.5	7.2	18.0
DITCH 6	9.3	102.6	12.9	56.3
AVE	9.1	55.0	12.6	36.7



First, what are the costs and returns?

Input/operation	Cost per acre
Seed	\$20-30
Planting the seed	\$10-12
Terminating the cover crop	\$0-10
Total	\$30-50

Returns	Return per acre
Yield increase	\$25 - 32
Nitrogen fertilizer savings	\$0-41 (corn) \$0-5 (soybean)
Weed and pest management	\$0-23
Grazing opportunities	\$19-38*

Plant certain types of cover crops based on your goals



Grasses

Annual ryegrass: nitrogen scavenger, erosion prevention, weed suppression



Legumes

Crimson clover: nitrogen source, erosion prevention

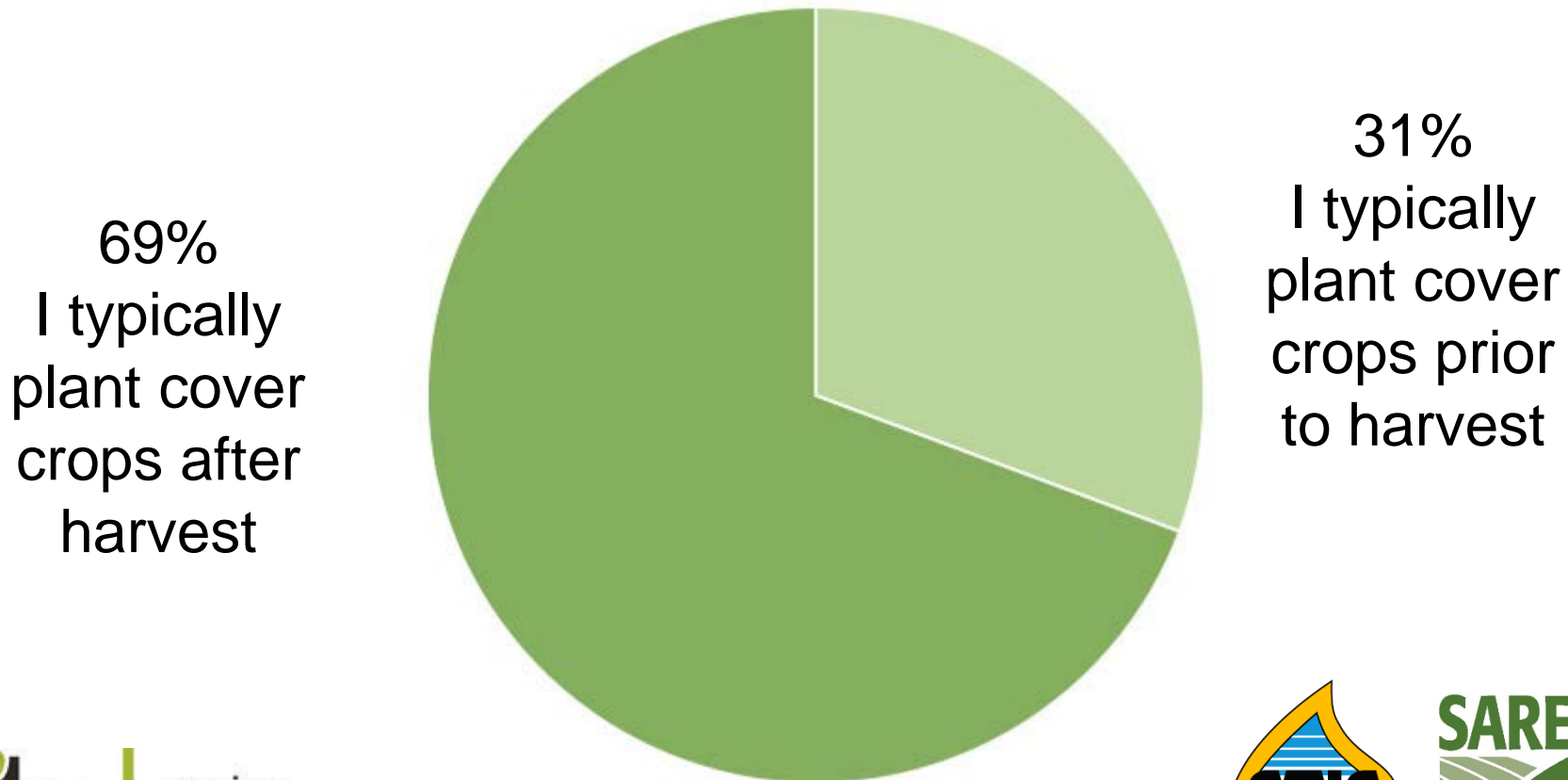


Brassicas

Forage radish: erosion prevention, weed suppression, soil compaction reduction

Photos: Edwin Remsberg

Timing of cover crop planting: (i) planting the cover crop prior to planting the cash crop in the spring, (ii) planting cover crops in-season during the summer, or (iii) planting cover crop in the fall following harvest.



Fall-Seeded Cover crops on sugarbeet



1

Winter rye



2

Winter camelina



3

Winter wheat



4

Oat



5

Radish



6

Check

Fall-Seeded Cover crops on sugarbeet

- Locations Prosper and Hickson, ND



NDSU

Statistical Analysis

RCBD. ANOVA was conducted across the two locations (LSD treatments was considered $P \leq 0.05$)

Fall-Seeded Cover crops on sugarbeet

- Locations Prosper and Hickson, ND

Sugarbeet planting (May, 2018
– June, 2019)

Sugarbeet Harvesting (October,
2018 – September, 2019)

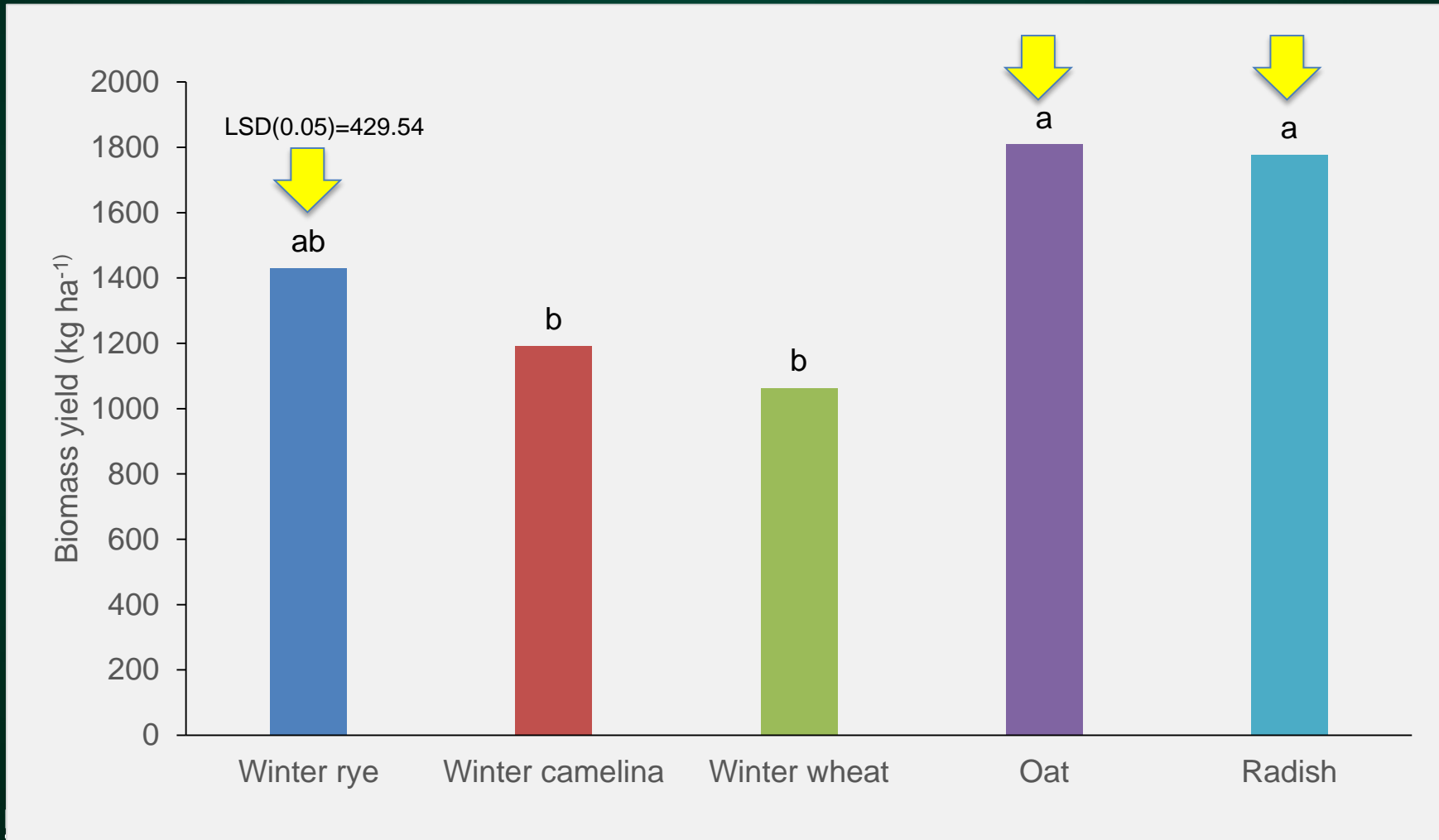


Statistical
Analysis

RCBD with split-plot arrangement ANOVA was conducted, CC as a main plot and N rates as a subplot (0 and 112 kg ha⁻¹). LSD treatments was considered $P \leq 0.05$

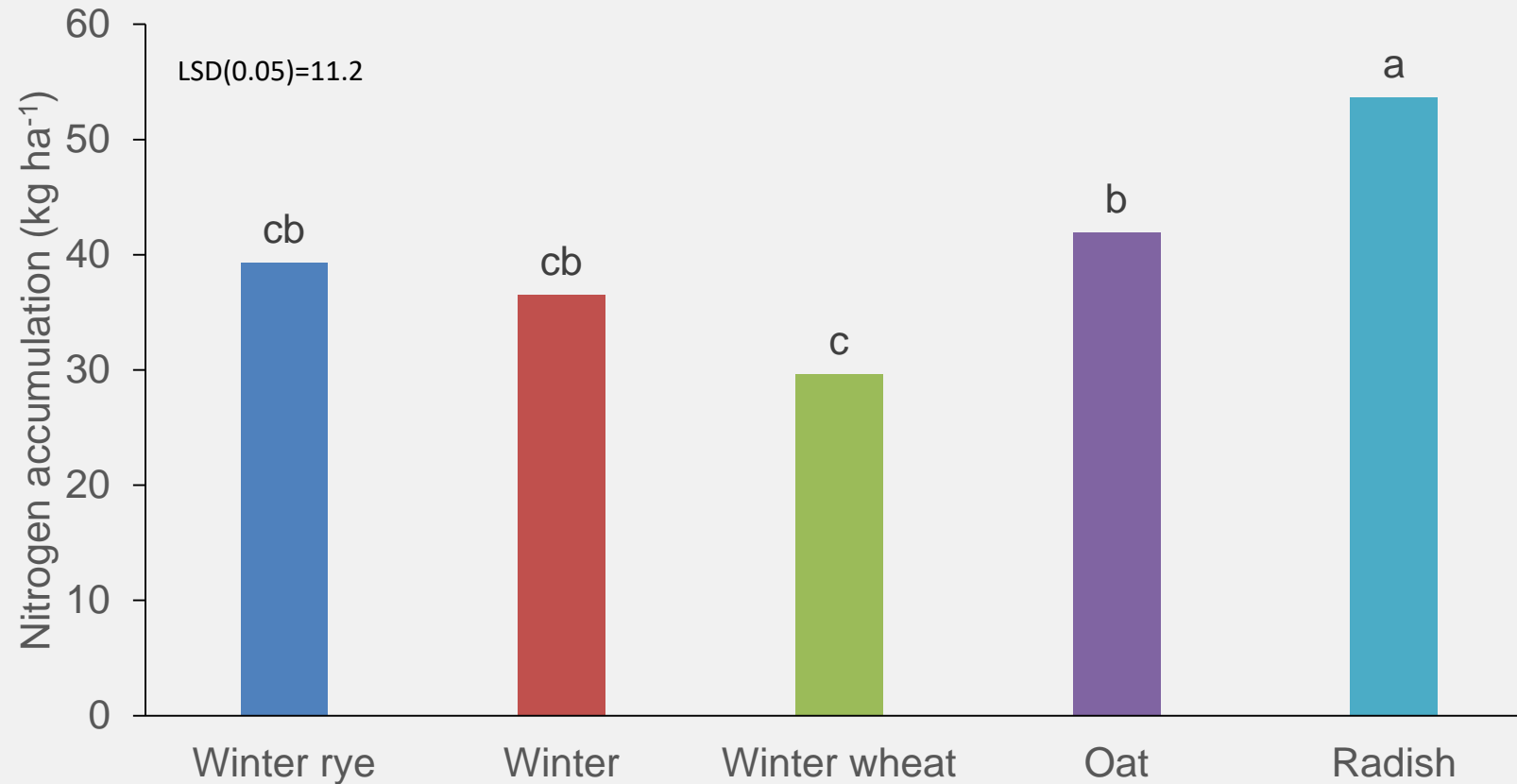
Results and Discussion

Biomass yield



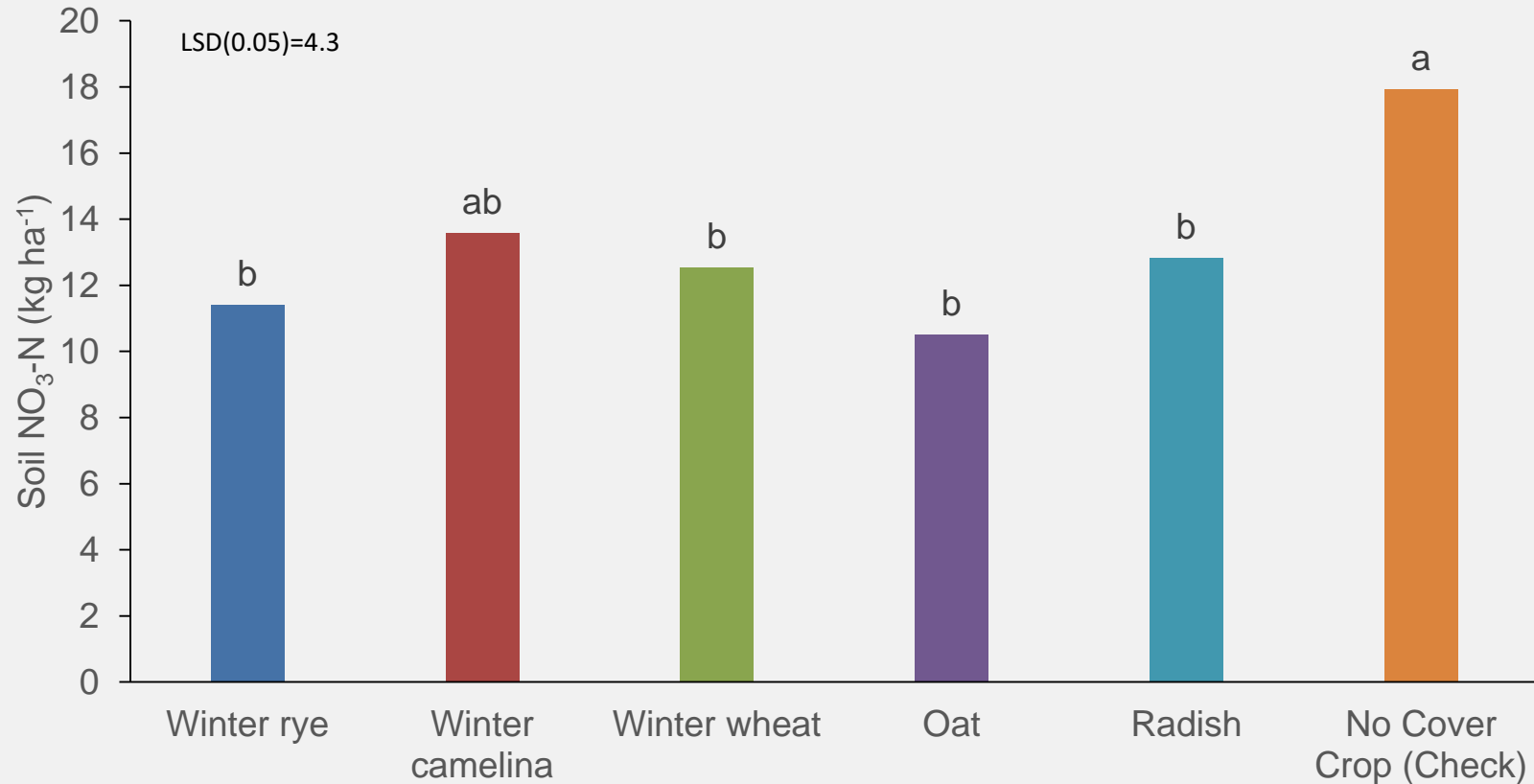
- Biomass yield was significantly higher in radish, oat, and winter rye.

Nitrogen accumulation



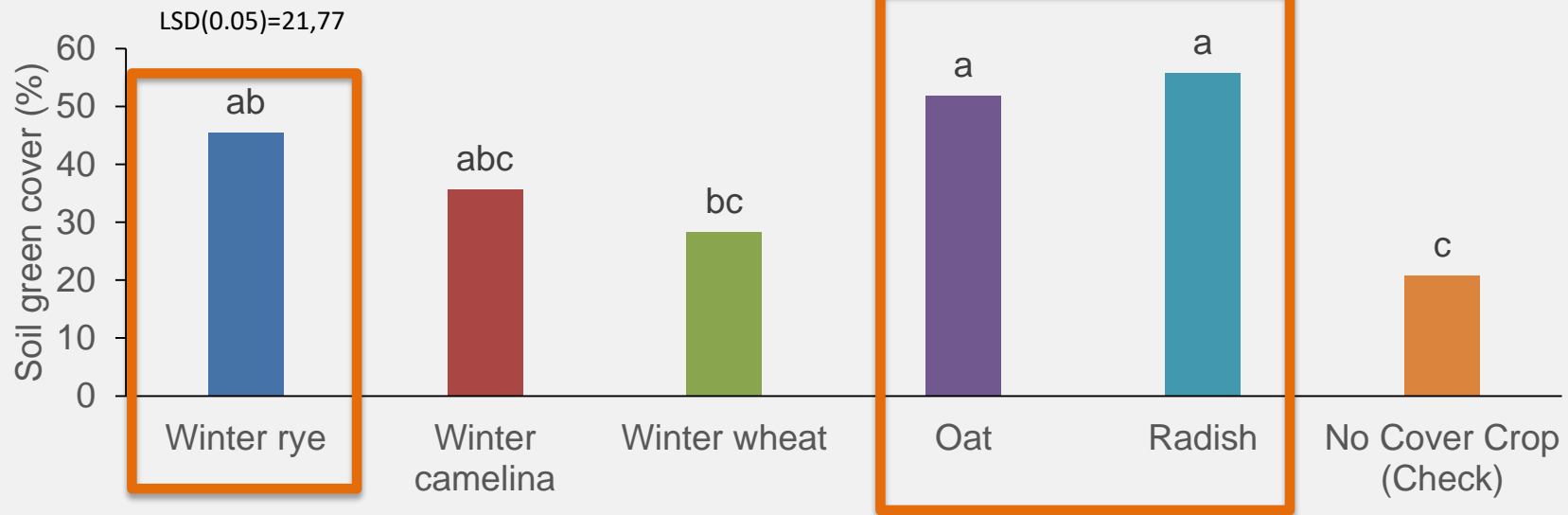
- Nitrogen accumulation in the biomass was significantly higher in radish and oat

Soil NO₃-N



- Soil NO₃-N was significantly higher in the check plot.
- Oat, radish, and winter rye had the NO₃-N lowest

Soil green cover



- Soil green cover was higher in oat, radish, and winter rye.

Oat



52%

Radish



56%

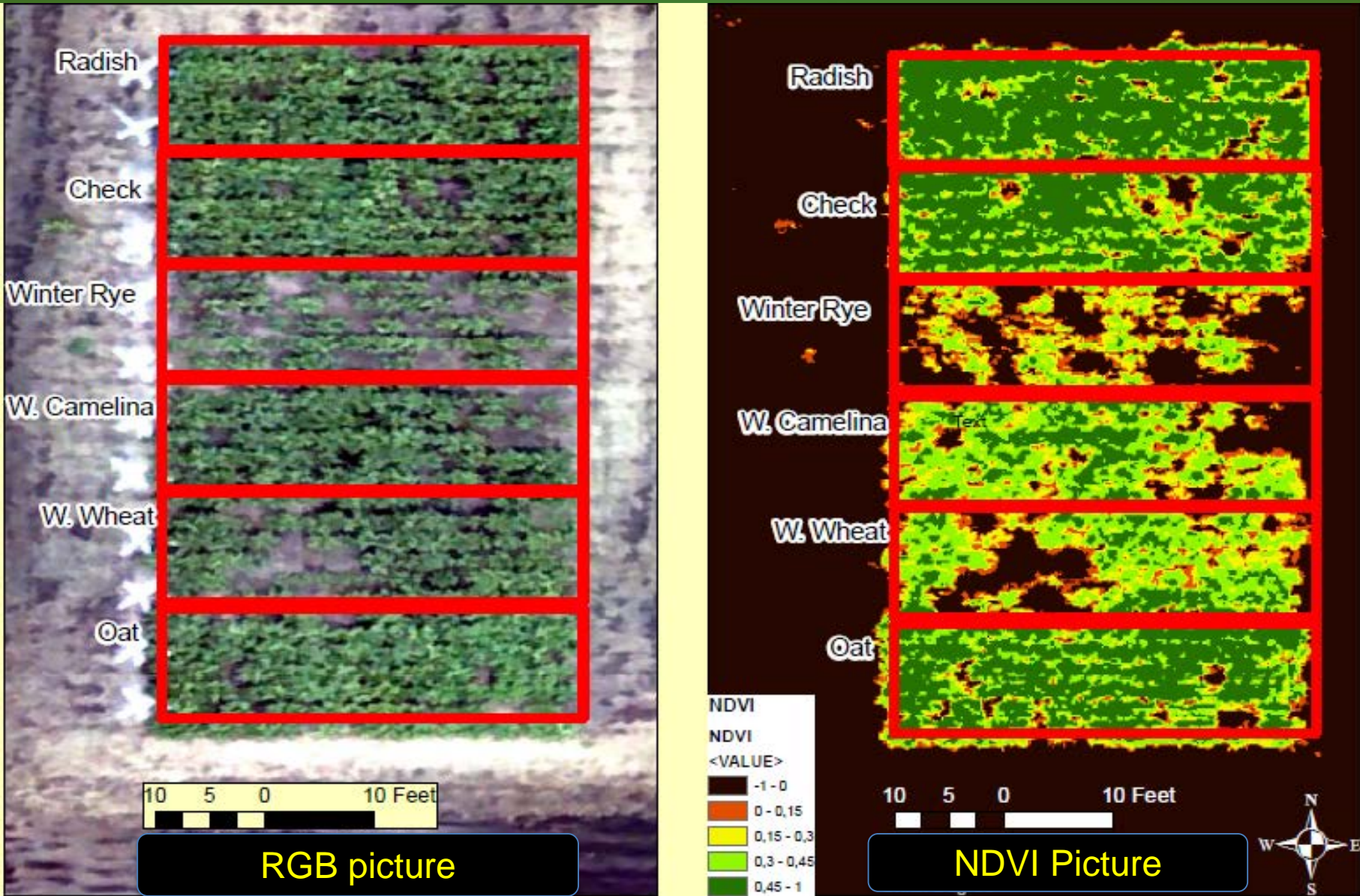
Winter rye



46%

Sugarbeet, something unexpected!

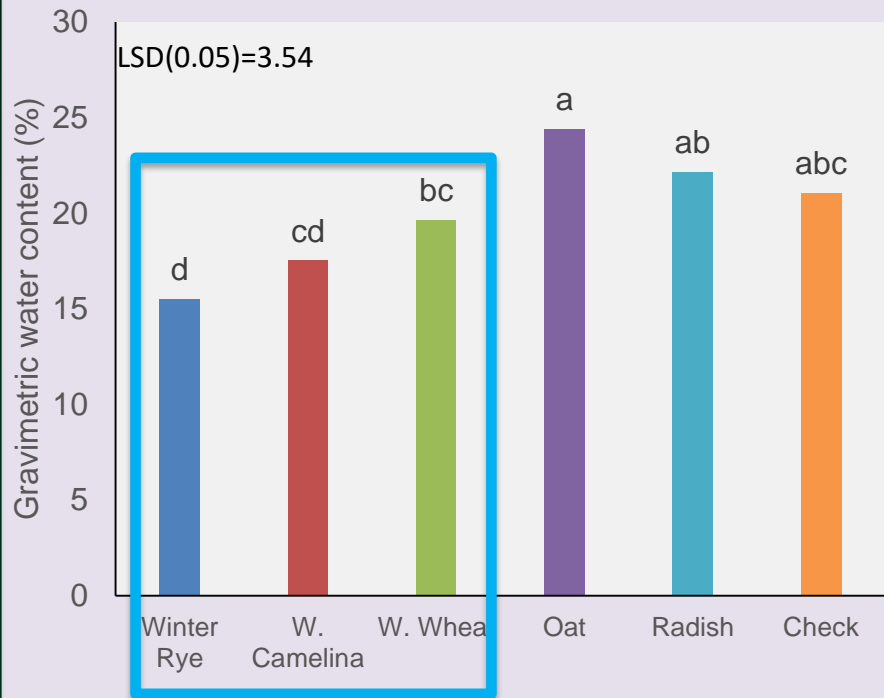
11th July, Hickson, ND



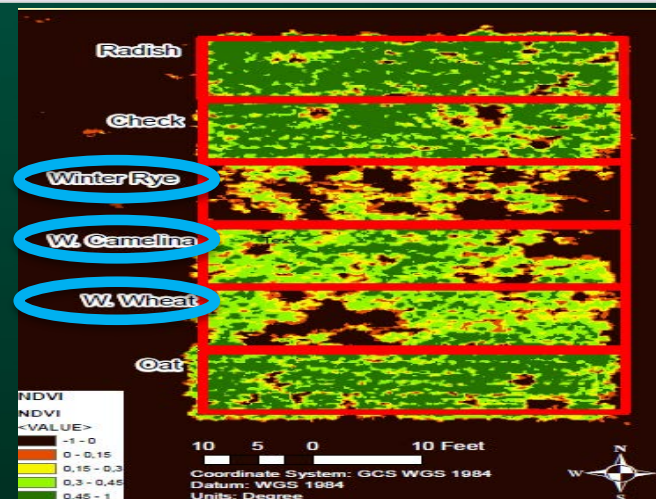
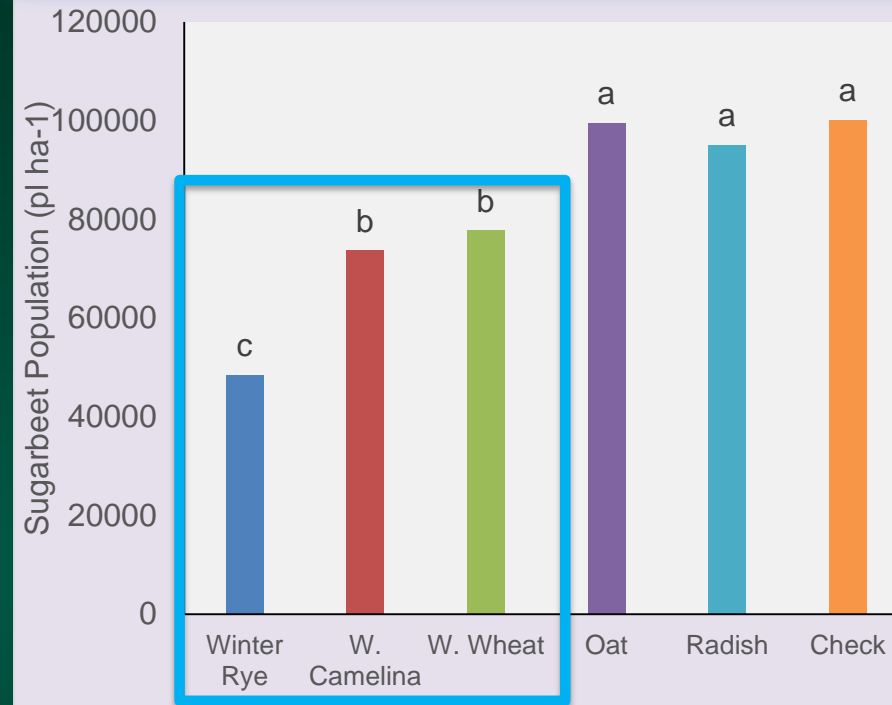
RGB picture

NDVI Picture

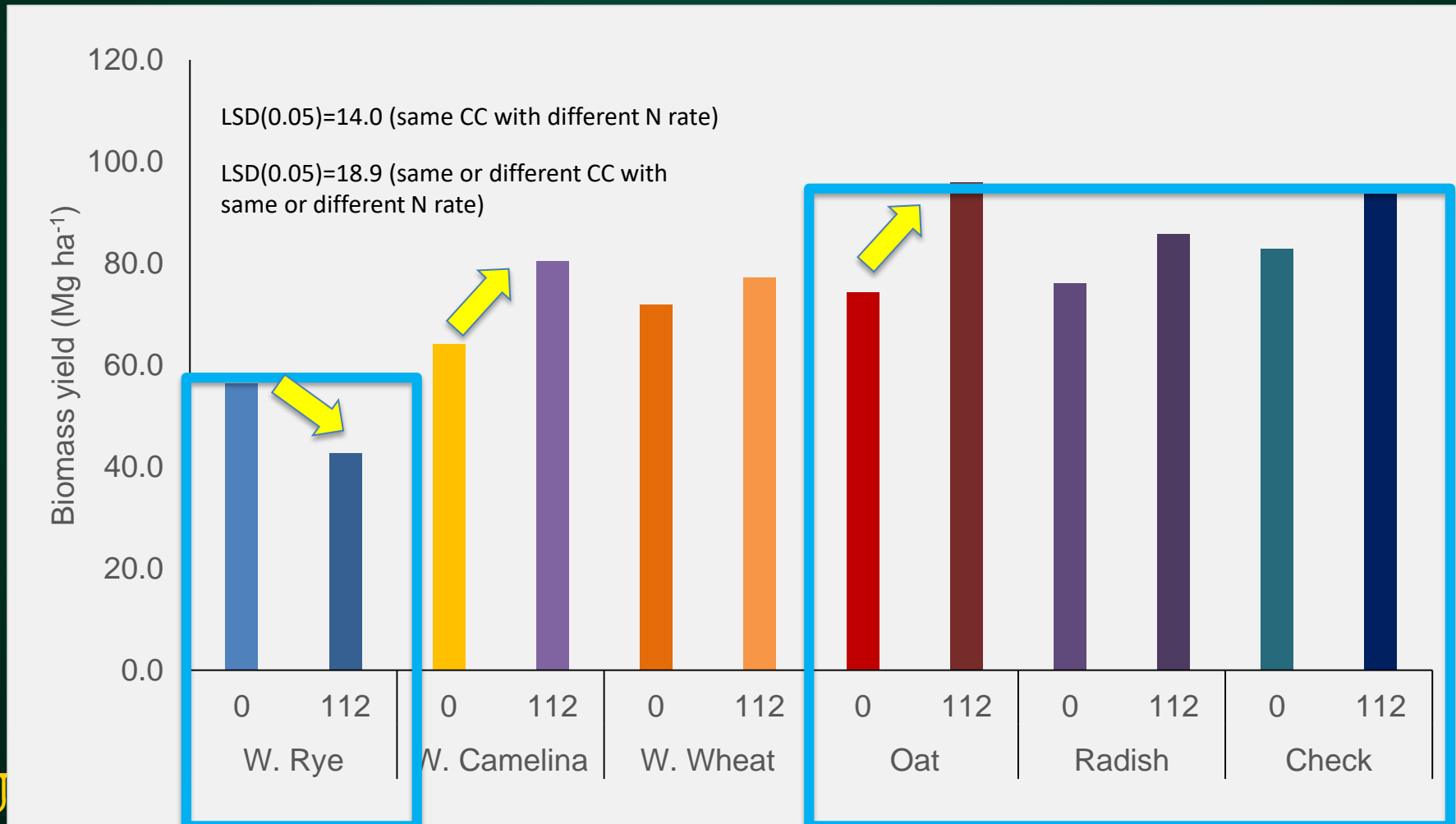
Gravimetric water content



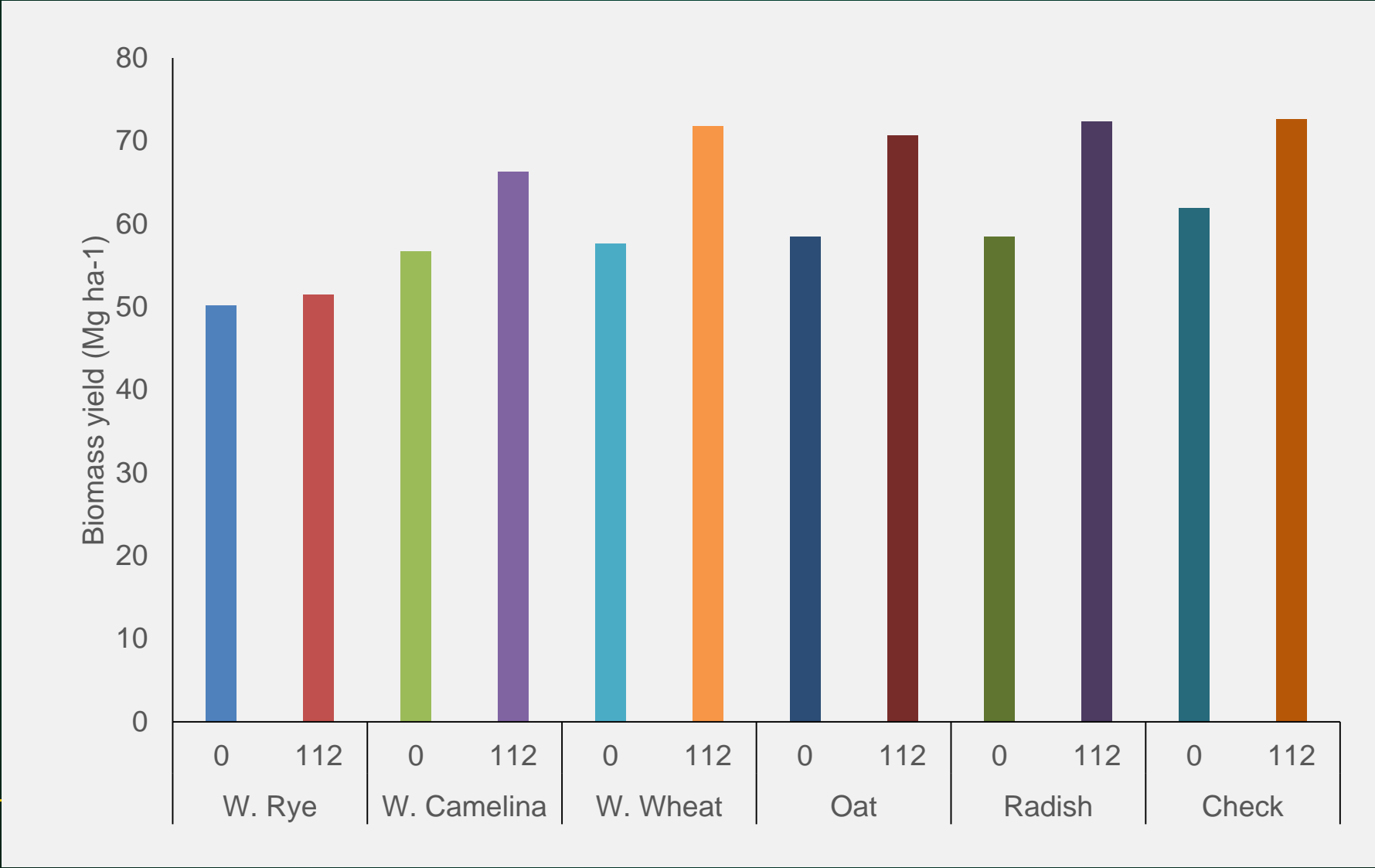
Sugarbeet plant population



Sugarbeet yield, Hickson 2018



Sugarbeet yield across 3 locations 2018-2019



Conclusions

Cover Crops

- Radish, winter rye, and oat provided soil cover, protecting the soil from erosion, and decreased soil residual $\text{NO}_3\text{-N}$ prone to leaching.

Winter Hardy CC

- Winter hardy cover crops take soil moisture in early spring, affecting sugarbeet germination, in some conditions.

Sugarbeet

- Sugarbeet yield and plant population was affected by winter hardy cover crops in a high clay soil in 2018 (Hickson)
- Opens the possibility of earlier Sugarbeet planting in heavy clay soils
- CC across locations did not affect Sugarbeet yield.

II. Cover Crop Interseeding under Sugarbeet Production



Fall seeded sorghum planted on Aug 20

Research Questions

1. Is there any chance of yield reduction due to interseeding?
2. Can we increase recoverable sugar with interseeding?
3. How interseeding will affect the profit?
4. Can we reduce the residual soil N after harvest?

Experiment plan

9 Treatments × 4 Replicates

Cover Crop Species:

- 1) Control (no cover crop),
- 2) Winter rye (20 lb/ac)
- 3) Winter camelina (6 lb/ac)
- 4) Winter Austrian pea (20 lb/ac)
- 5) Mustard (10 lb/ac)

2018

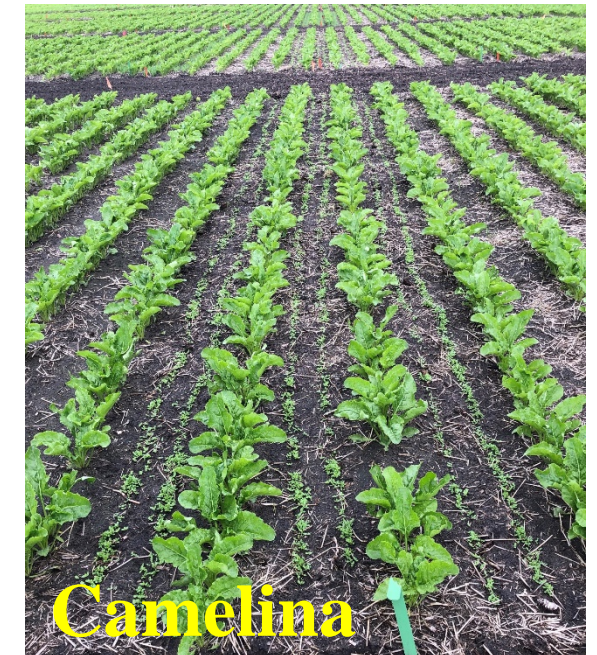
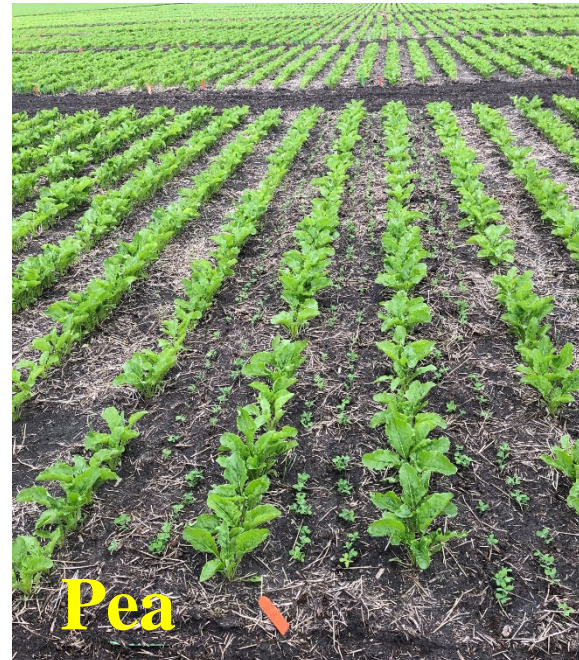
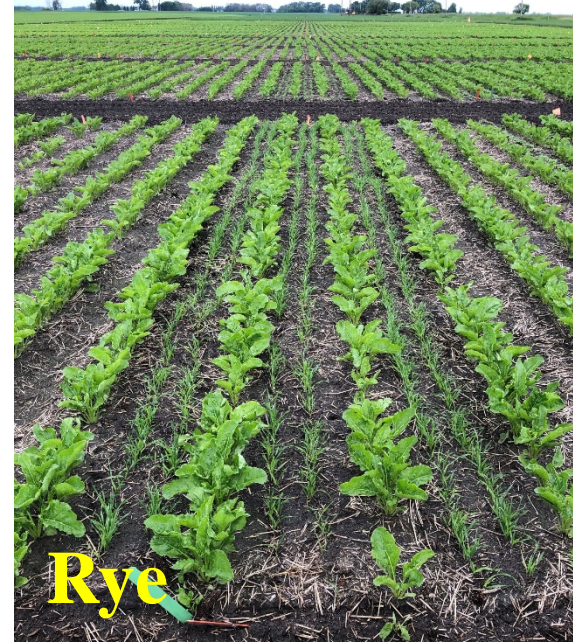
1st Planting: Ada- June 21

2nd Planting: Ada – July 11

2019

1st Planting: Ada- June 13

2nd Planting: Ada – June 24



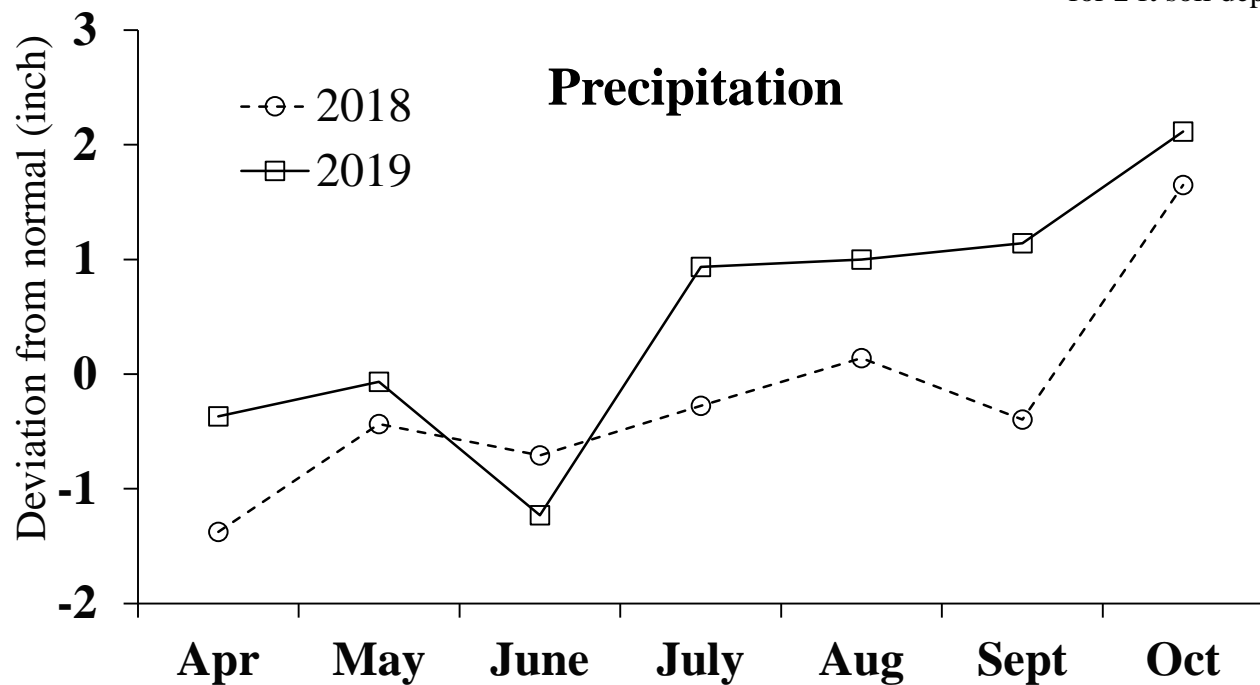
Picture taken on June 25,2019

Experiment plan

Experimental Design: RCBD (check, four cover crops at two planting date) **Plot size:** 30 ft × 11 ft

	Soil N* (lb/ac)	Olsen P (ppm)	K (ppm)
2018	38	5	67
2019	41	8	93

*for 2 ft soil depth



1st Is there any chance of yield reduction due to interseeding?

Differences in sugarbeet root yield (ton/ac) due to cover crop inter-seeding during 2018 and 2019 at Ada

	2018	2019
<i>Check</i>	37.6	30.9
<u>1st Planting</u>	June 21	June 13
Rye	-1.52 ^{C*}	-9.22 ^D
Mustard	1.40 ^A	-8.46 ^D
Pea	-1.34 ^C	-5.42 ^{CD}
Camelina	-0.61 ^{BC}	-3.88 ^{BC}
<u>2nd Planting</u>	July 11	June 24
Rye	0.49 ^{AB}	-0.10 ^{AB}
Mustard	-0.56 ^{BC}	1.21 ^A
Pea	0.78 ^{AB}	2.68 ^A
Camelina	0.61 ^{AB}	3.30 ^A

*Different letters indicate significant difference between means at 95% significance level

2nd Can we increase recoverable sugar with interseeding?

Differences in recoverable sugar yield (lb/ac) due to cover crop inter-seeding during 2018 and 2019 at Ada

	2018	2019
<i>Check</i>	11,562	9,219
<u>1st Planting</u>	June 21	June 13
Rye	-176 ^C	-2503 ^D
Mustard	792 ^A	-2605 ^D
Pea	95 ^{BC}	-1639 ^{CD}
Camelina	195 ^{ABC}	-904 ^{BC}
<u>2nd Planting</u>	July 11	June 24
Rye	500 ^{AB}	-33 ^{AB}
Mustard	298 ^{ABC}	481 ^A
Pea	434 ^{AB}	495 ^A
Camelina	395 ^{ABC}	777 ^A

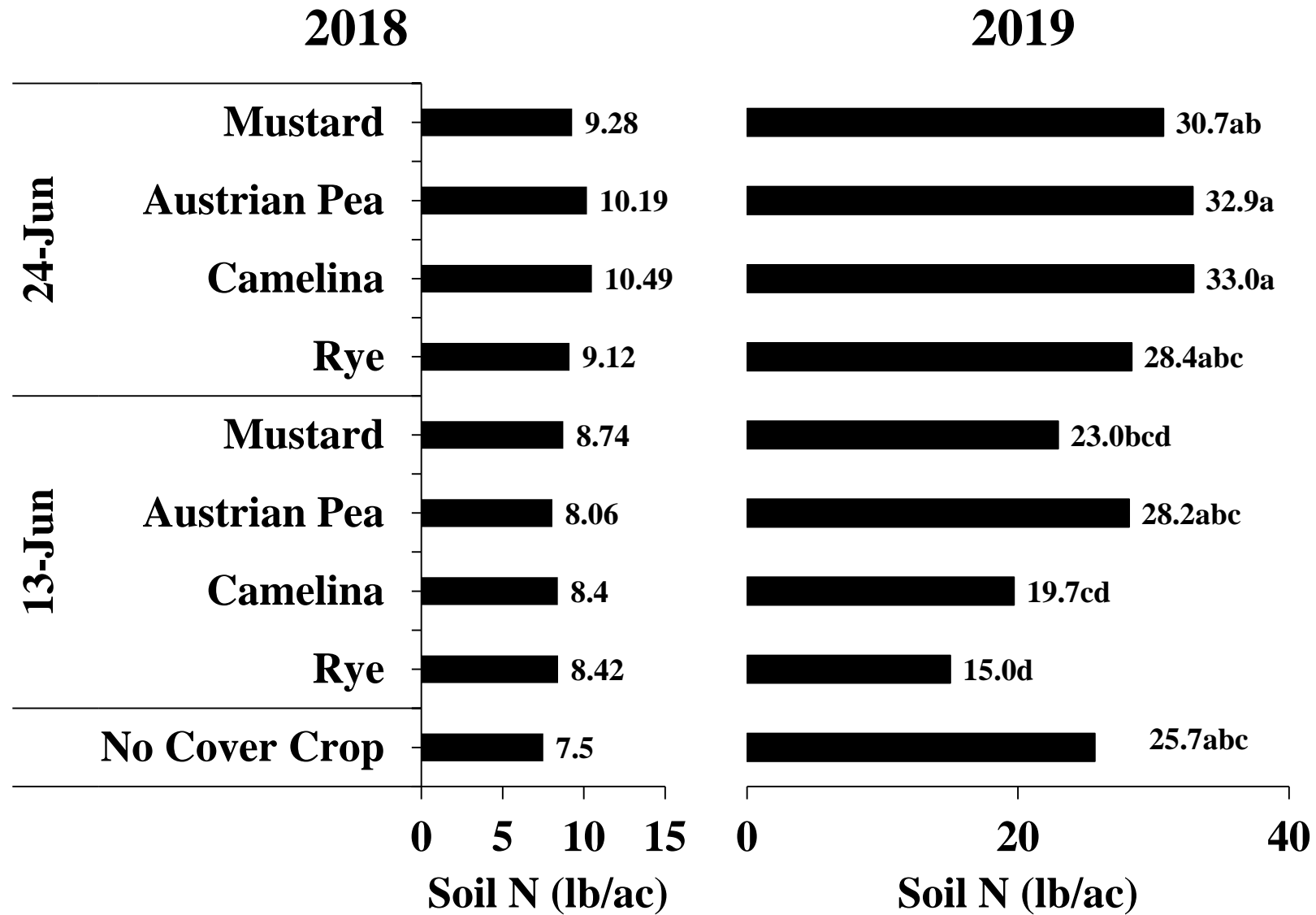
*Different letters indicate significant difference between means at 95% significance level

3rd How inter-seeding will affect the profit?

Differences in economic return (\$/ac) due to cover crop inter-seeding during 2018 and 2019 at Ada

	2018	2019
<i>Check</i>	1407	946
<u>1st Planting</u>	June 21	June 13
Rye	-88	-209
Mustard	35	-282
Pea	-4	-172
Camelina	-49	-44
<u>2nd planting</u>	July 11	June 24
Rye	46	-4
Mustard	20	72
Pea	48	-8
Camelina	31	40

4th Can we reduce the residual soil N after harvest?



Cover crops fill up the gaps

Downer July 9, 2018



September 18, 2018



September 18, 2018



Cover Crop Biomass at Harvest
(Sept 16, 2019)



Regrowth of cover crop after
harvest (Oct 17, 2019)



Without cover crop (April 24, 2019)

Over-wintered Rye (April 24, 2019)



Biomass : 3.9 Mg/ha

Cover cropping can be an effective management tool for erosion control

Cover crop inter-seeding under sugarbeet

- Cover crop inter-seeding under sugarbeet has potential to increase yield, recoverable sugar, and profit.
- Planting time play a crucial role- too early can reduce yield probably due to competition for nitrogen
- Favorable time window- between 3rd wk, June and 2nd wk, July
- Selection of cover crop species decides the magnitude
- Brassica family (Camelina and mustard) did better than cereal and legume.
- Winter rye can grow back in spring and can increase the benefit of soil and nutrient retention