

## Introduction

- Nutrient Loss Reduction Strategy (Illinois NLRS, 2017), suggests winter cereal cover crops (WCCCs) are the best on-farm practices to reduce N loss in corn-corn or corn-soybean cropping systems.
- Solid row planting a WCCC such as winter rye (WR) before corn (NP) generally results in intersecting zones between WR and corn (Fig. 1A) that could decrease corn yield as a result of reduced N availability in spring. This is mainly due to N immobilization caused by high C:N ratio of WR residue or soil moisture depletion by the WR early in the spring.
- One strategy to alleviate WR issues behind corn is precision planting or skipping the corn row (STCR). STCR is a farmer driven approach that avoid intersecting zones between corn roots and WR roots by omitting WR on the row in which corn will be planted (Fig. 1B).

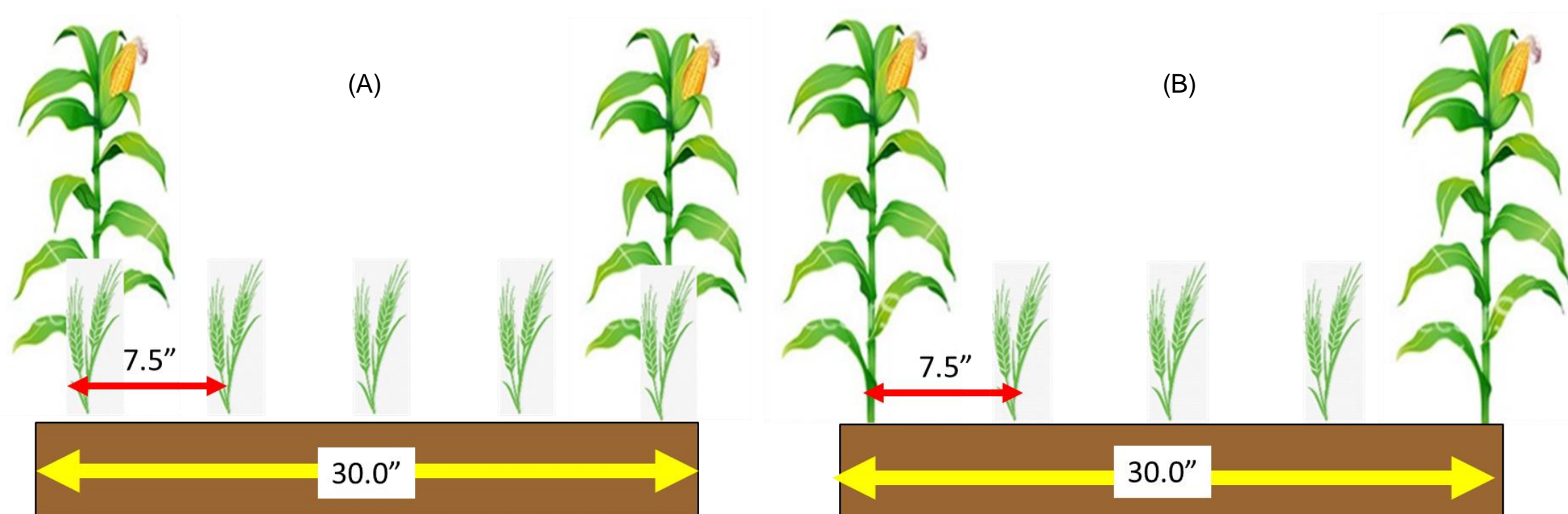


Fig. 1. Schematic presentation of solid planting of WR (A) and skipping the corn row (STCR; B).

## Research Questions

- Does STCR biomass, nutrient concentration and content, CC quality (C:N ratio; lignin:N ratio) differ from NP?
- Will STCR decrease the cost of CC planting due to the lower seed used in the "skipped row"?
- Will soil temperature be higher in STCR than NP.
- Can STCR decrease corn N requirement and partial N balance?

## Materials and Methods

### Study Sites

Trials were conducted at the Agronomy Research Center (ARC, Carbondale, IL) in 2019, 2020, 2021 growing seasons and at Belleville Research Center (BRC, Belleville, IL) in 2020 and 2021 growing seasons.

### Experimental Design and Treatments

- Experimental design was a randomized complete block design with split plot arrangement and four replicates.
- Main plots were WR planting methods including a no-CC control, normal planting of WCR (NP), and precision planted WCR (STCR).
- The subplots were six N rates ranging from 0 to 280 kg N ha<sup>-1</sup> (0-250 lbs ac<sup>-1</sup>).

## Materials and Methods (Cont.)

### WR Management and Measurements

- WR was planted between Oct. 23 (ARC 2020) to Nov. 12 (ARC 2019).
- WR seeding rate was 100 kg ha<sup>-1</sup> (90 lbs ac<sup>-1</sup>).
- WR was terminated as early as April 14 (BRC 2020) to May 4 (ARC 2019).

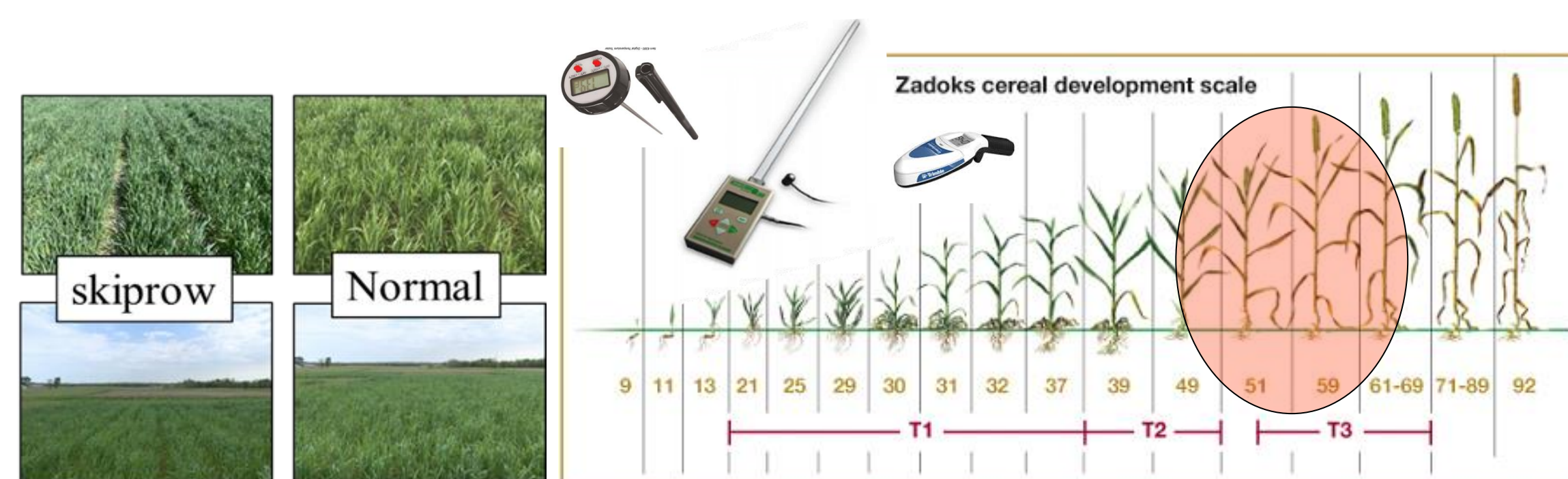


Fig 2. Winter cereal rye planting methods (STCR vs. NP) (left) and measurements (right) each year.

### Corn Management and Measurements

- Corn [DKC 62-08, 64-35 (ARC); 64-34 (BRC)] was planted between May 14 (ARC 2020) and June 4 (BRC 2020).

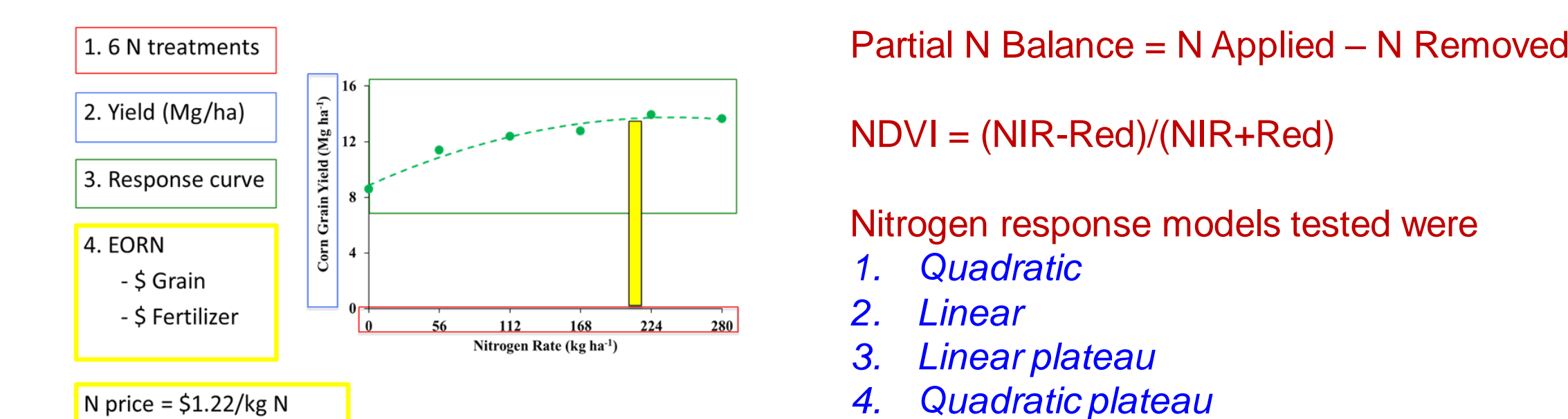


Fig 3. Corn EORN calculation (left) using grain and corn prices in quadratic plateau model.

## Results and Discussion

### Winter Cereal Rye Performance

Table 1. Effect of WR planting method (STCR vs. NP) and site-yr on WR dry matter (DM) yield, leaf area index (LAI), normalized difference vegetative index (NDVI), and plant height. Mean separation by LSD; Different letters indicate significant differences among treatments at 0.05.

Site-yr	DM biomass Mg ha <sup>-1</sup>	LAI	NDVI	Plant height cm
ARC2019	0.85 d	-	0.34 b	48.5 a
ARC2020	3.13 a	1.65 bc	0.66 a	47.9 a
BRC2020	3.24 a	2.48 a	0.68 a	51.8 a
ARC2021	2.25 c	1.92 b	0.55 b	42.2 b
BRC2021	2.67 b	1.33 c	0.60 b	79.0 a
P value	<0.0001	0.0018	<0.0001	<0.0001
Treatments				
NP	2.33 a	1.72 a	0.56 a	53.4 a
STCR	2.53 a	1.97 a	0.58 a	54.2 a
P value	0.0786	0.1726	0.1967	0.5477

STCR had similar DM biomass, LAI, NDVI, and plant height to NP.

STCR had higher soil temperature (1 °C) than NP which is desirable for quicker corn emergence (data not shown).

WR N and C concentration varied by planting methods in site-yrs (Fig. 4A-B).

STCR increased WR P and K uptake compared to NP (Fig. 4C-D).

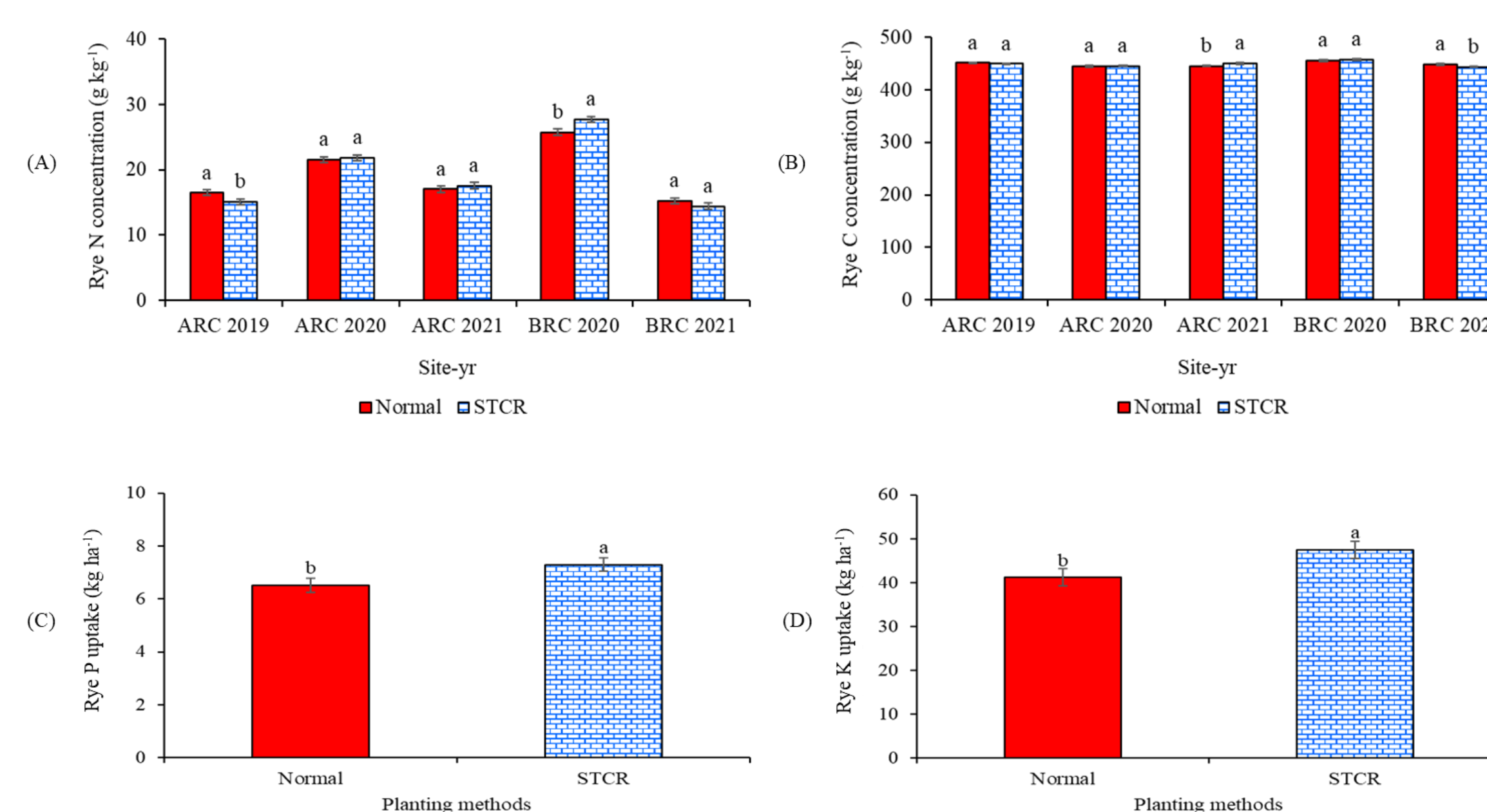


Fig. 4. Effect of WR planting method (STCR vs. NP) and site-yr on WCR N concentration (A), C concentration (B), P uptake (C) and K uptake (D). Mean separation by LSD; Different letters indicate significant differences among treatments at 0.05.

## Results and Discussion

### STCR Economic Benefit

Table 2. Comparing WCR cost of planting for STCR vs. NP.

Treatment	WCR seeding rate	Price of WCR seeds	Total seed costs	\$ saved by STCR
	kg ha <sup>-1</sup>	\$ kg <sup>-1</sup>	\$ ha <sup>-1</sup>	\$ ha <sup>-1</sup>
NP	100	0.336	33.6	-
NP	100	0.672	67.2	-
NP	100	1.008	100.8	-
NP	100	1.344	134.4	-
NP	100	1.680	168.0	-
STCR	75	0.336	25.2	8.4
STCR	75	0.672	50.4	16.8
STCR	75	1.008	75.6	25.2
STCR	75	1.344	100.8	33.6
STCR	75	1.680	126.0	42.0

STCR can save at least \$8.4 per hectare (\$3.5 per acre) for growers.

### Corn Grain Yield, N Removal, and N Balances

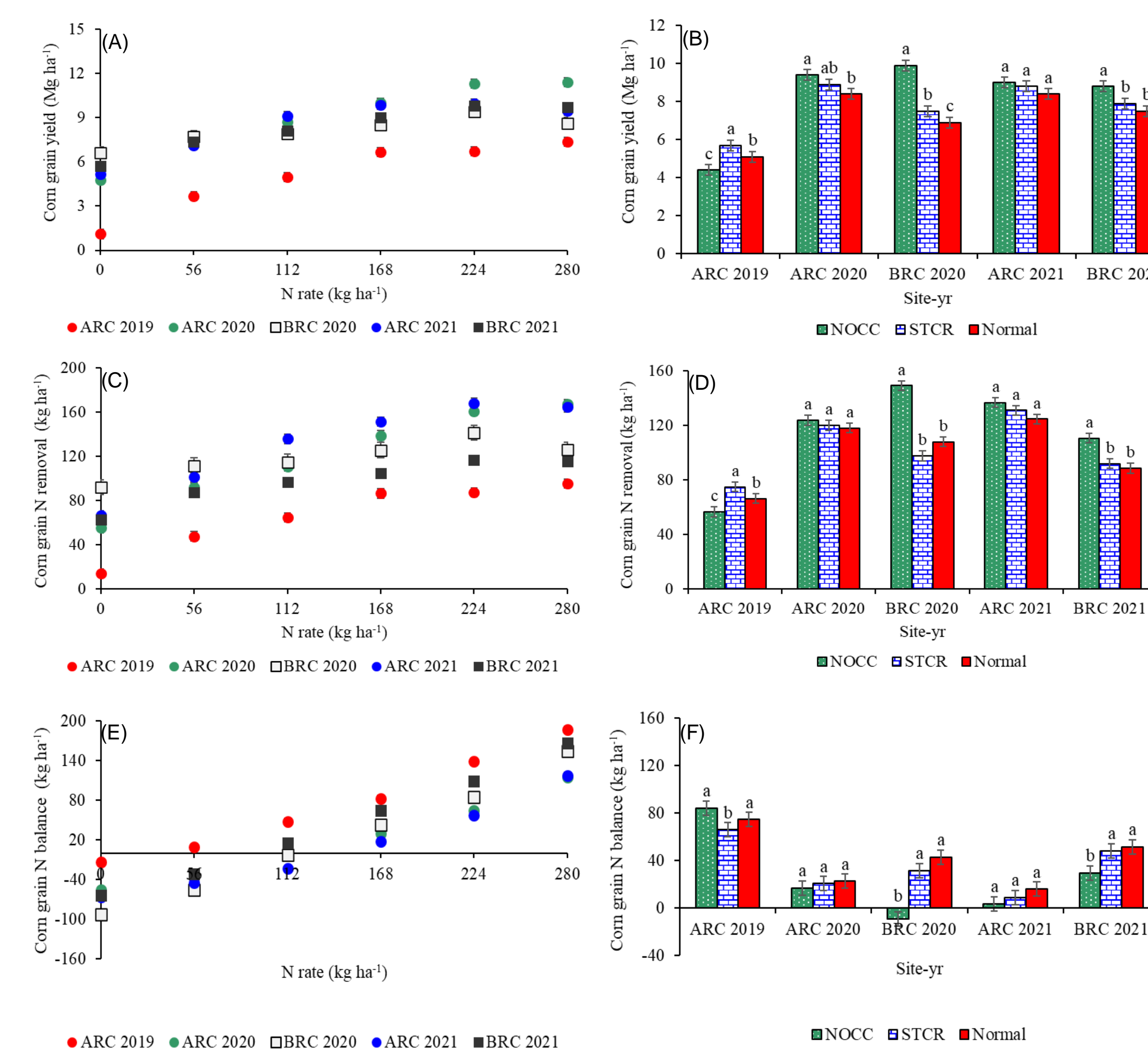


Fig. 5. Corn grain yield, N removal, and balance response to site-yr by N rate (Fig. 5A, C, and E) along with site-yr by cover crop interaction (Fig. 5B, D, and F). Mean separation by LSD; Different letters indicate significant differences among treatments at 0.05.

1. EORN ranges from 0 (NoCC BRC2020) to 255 kg ha<sup>-1</sup> (NP ARC2021).

2. STCR in 2 site-yr decreased EORN by 6 and 8 kg ha<sup>-1</sup> but at each year resulted in higher corn grain yield reflecting on warmer soil temperature on the skipped corn row and increased plant population (data not shown).

3. Adding N above the EORN increases N balances exponentially. No-response to N in NoCC at BRC2020 resulted in a linear increase of N balance.

## Answers to Research Questions

- Does STCR biomass, nutrient concentration and content, CC quality (C:N ratio; lignin:N ratio) differ from NP? **Not much!** STCR increases P and K uptake otherwise, differences were site-specific
- Will STCR decrease the cost of CC planting due to the lower seed used in the "skipped row"? **Yes!**
- Will soil temperature be higher in STCR than NP? **Yes!** It was 1 °C higher in STCR than NP.
- Can STCR decrease corn N requirement and partial N balance? **Yes!**

## Acknowledgements

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