

Introduction

- Nitrate loss in row crop agriculture remains a global concern due to its impact on the environment. To this effect, the Illinois Nutrient Reduction Strategy has set a goal to reduce nitrate-N leaching up to 15% by 2025 (IL NLRs 2015). Planting cover crops (CCs) including cereal rye (CR; *Secale cereale* L.) has been recommended as the most effective strategy to manage nitrate-N leaching. However, growers are reluctant to plant cover crops such as cereal rye in corn (C; *Zea mays* L.)-soybean (S; *Glycine max* L.) rotation.
- Double cropping corn-wheat (W; *Triticum aestivum* L.)-soybean, however, is fairly common in Southern Illinois. While the economic potential of double cropping wheat and soybean is well established (Tsiboe *et al.*, 2017), literature is limited on effects of N and P loss during wheat and soybean growing seasons at different N management intensities during wheat production season.

Objectives

- This trial evaluated the effect of N management during the wheat growing season on wheat yield, nitrate-N and phosphate leaching, compared to soybean yield, nitrate-N and phosphate leaching, and yield-scaled N leaching in no-cover crop, cereal rye, and wheat-soybean double cropping systems.

Experimental Site, Design and Treatments

The study was laid out in a Randomized Complete Block Design (RCBD) with four replicates in 2021 and 2022 at Agronomy Research Center (ARC), Carbondale and Belleville Research Center (BRC), Belleville.

Treatments were:

- C-S-no-CC (control) (A)
- C-CR-S-CR (maximum nitrate-N reduction control) (B)
- C-W (low input)-S-no-CC (C)
- C-W (medium input)-S-no-CC (C)
- C-W (high input; NREC growers' suggestions)-S-no-CC (C)
- C-W (low input)-S-CR (D)
- C-W (medium input)-S-CR (D)
- C-W (high input; NREC growers' suggestions)-CR (D)

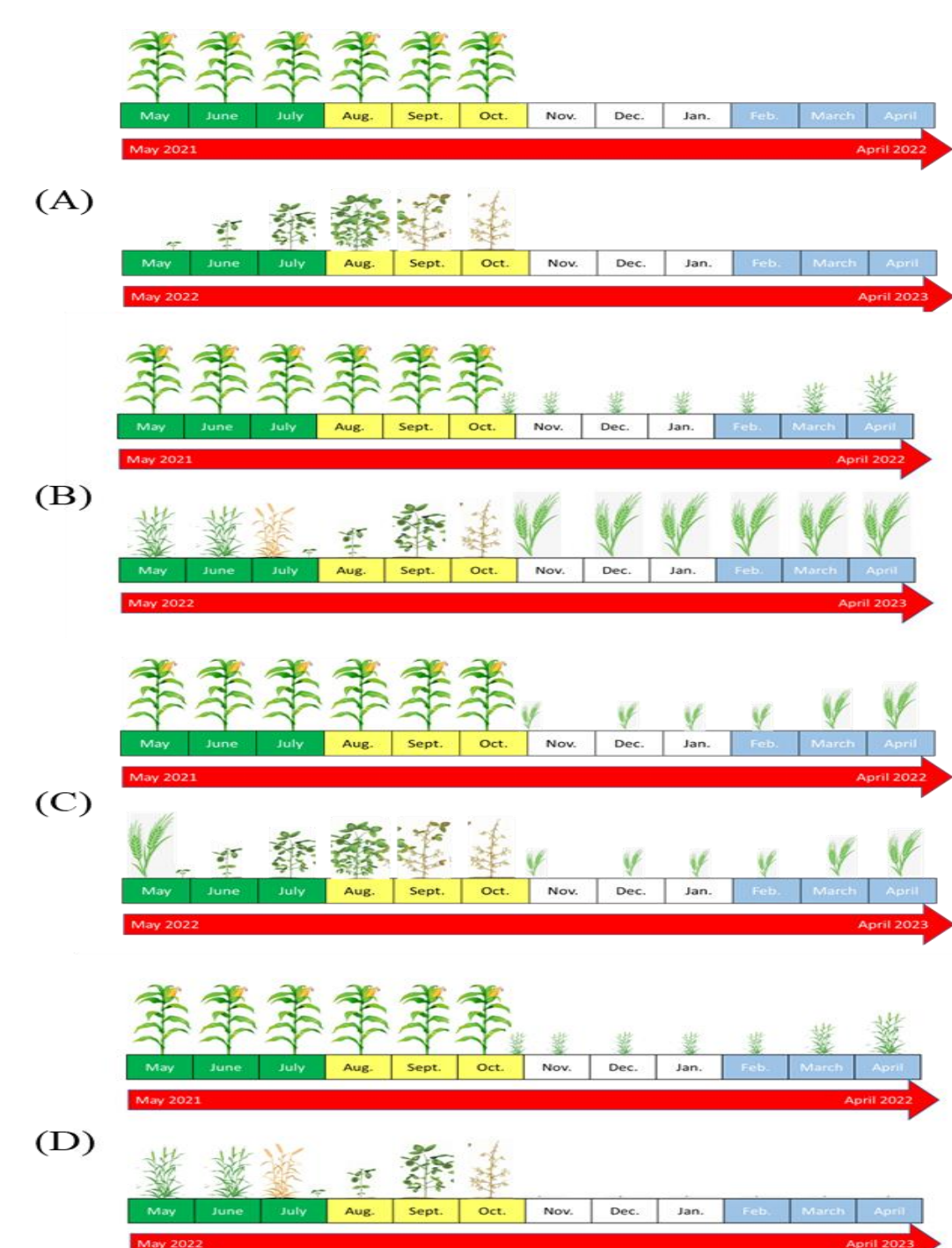


Fig. 1. Schematic of crop rotations over a two-year period at both (ARC and BRC) locations.

Acknowledgements

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Trial Management

ARC Site

- A no-till drill was used to plant wheat (var. AgriMaxx 495) and CR (var. SoilFirst) on October 26, 2021, at 125 lbs acre⁻¹ and 78 lbs acre⁻¹, respectively.
- For wheat, fertilizer rate (166 lbs acre⁻¹) was similar between medium (all N spring) and high intensity (fall and spring) management during wheat but higher than the low intensity management (107 lbs acre⁻¹). Cereal rye was terminated on May 11, 2022, while wheat was harvested on June 22, 2022.
- At ARC, soybeans (var. Asgrow 47xF0) was planted after termination of rye and harvesting of wheat on May 18 (single season) and June 22, 2022 (double crop). Soybean was harvested and cereal rye planted on October 24, 2022.

BRC Site

- Wheat and CR were planted on November 5, 2021, and November 10, 2021, respectively. Wheat was harvested on June 23, 2022, while rye was terminated on May 11, 2022.
- Soybean planting dates were May 26 (single season), and June 24, 2022 (double crop). Soybean was harvested and cereal rye planted on October 24, 2022.

Measurements

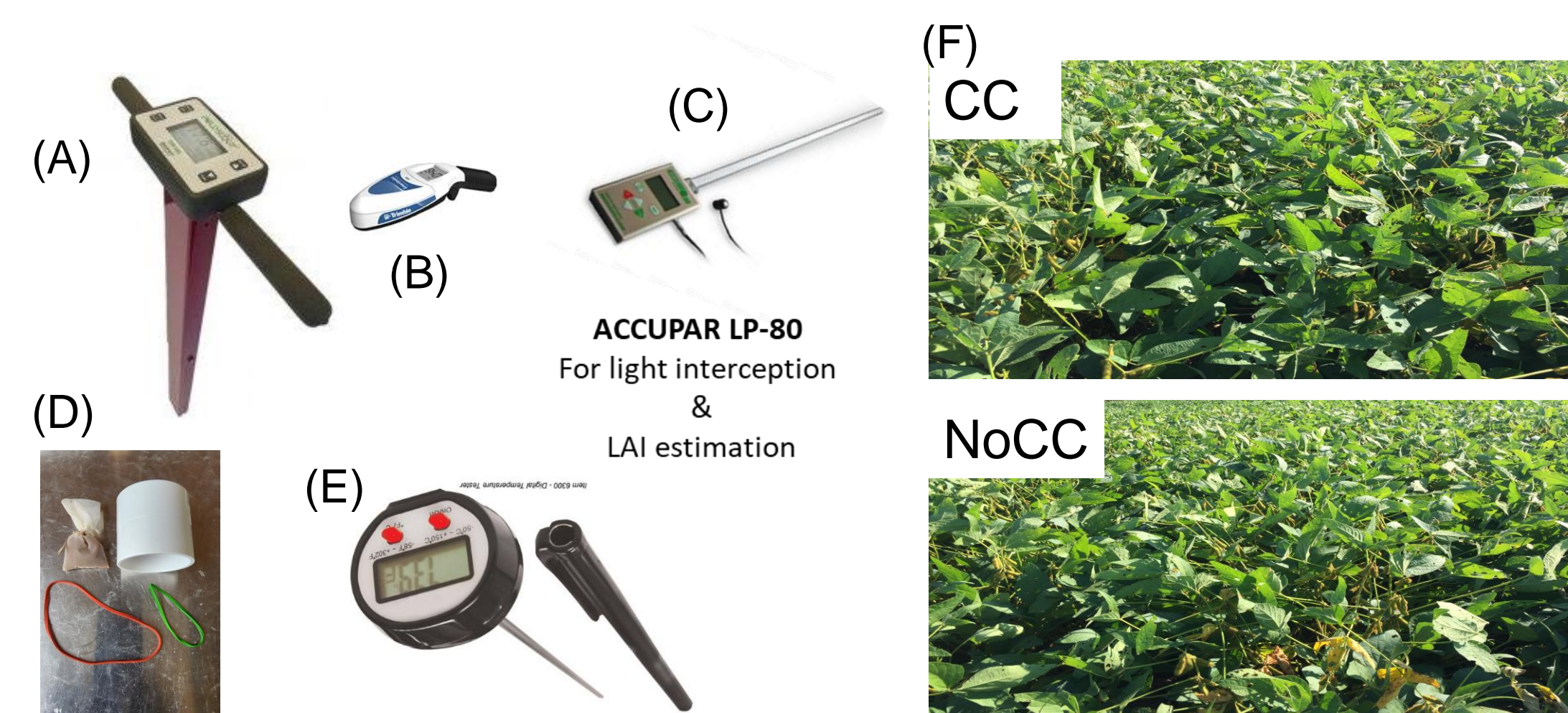


Figure 2. TDR 350 (A), GreenSeeker (Trimble) (B), ACCUPAR LP-80 for measuring LAI (C), materials for constructing lysimeter (D), Soil thermometer (E), and soybean growth in a no-cover crop (NoCC) vs. CR (CC) rotation (F).

Results and Discussion

Wheat Biomass and Grain Yield

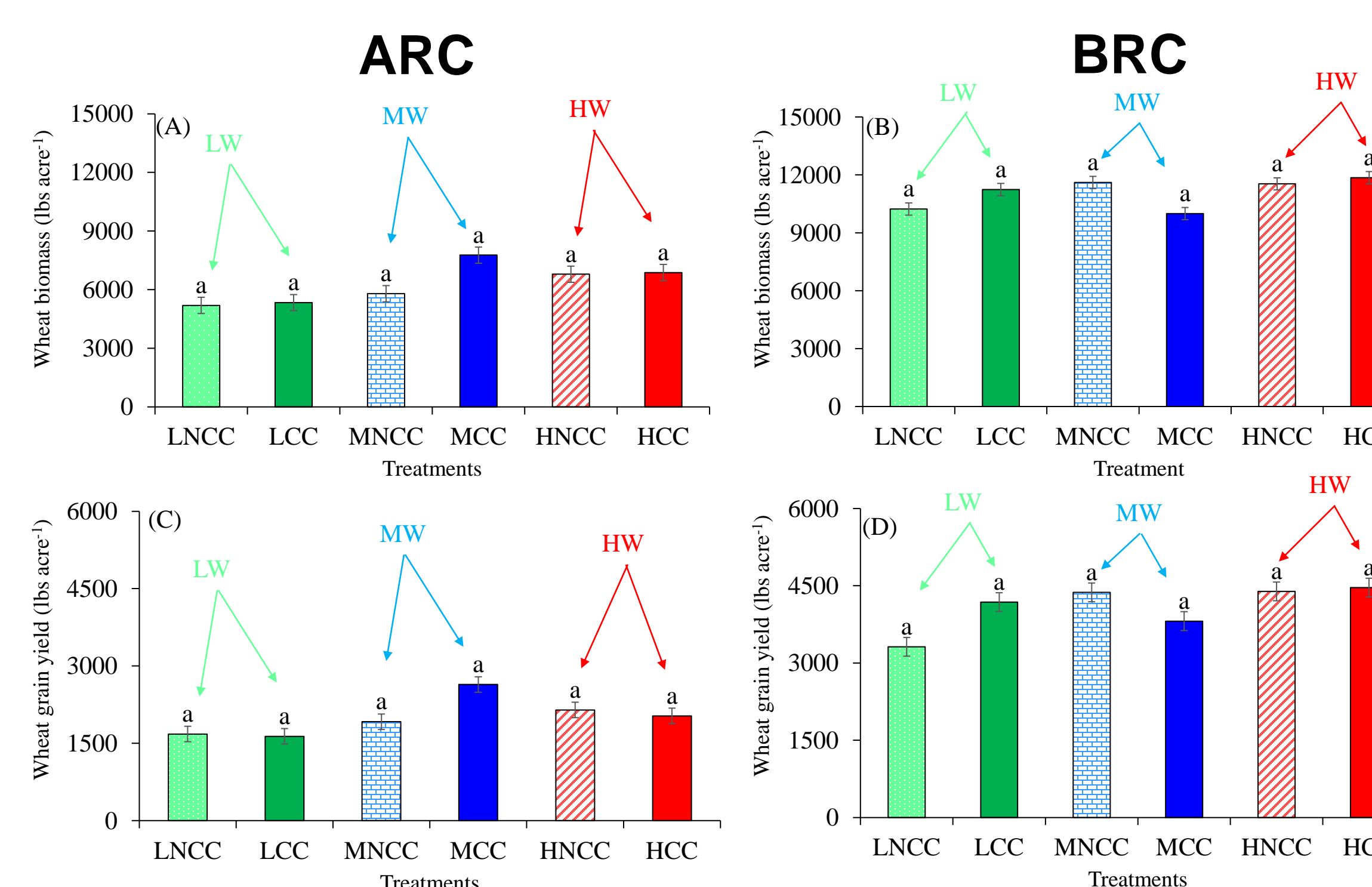


Fig. 3. Response of winter wheat biomass (A-B) and grain yield (C-D) to different N fertility management intensities and crop rotation. Error bars are standard error. LNCC: low N rate with no cover crop; LCC: low N rate with CC; MNCC: medium N management with no cover crop; MCC: medium N management with CC; HNCC: high N management with no cover crop; HCC: High N management with CC.

N and P Leaching in Wheat Phase (BRC)

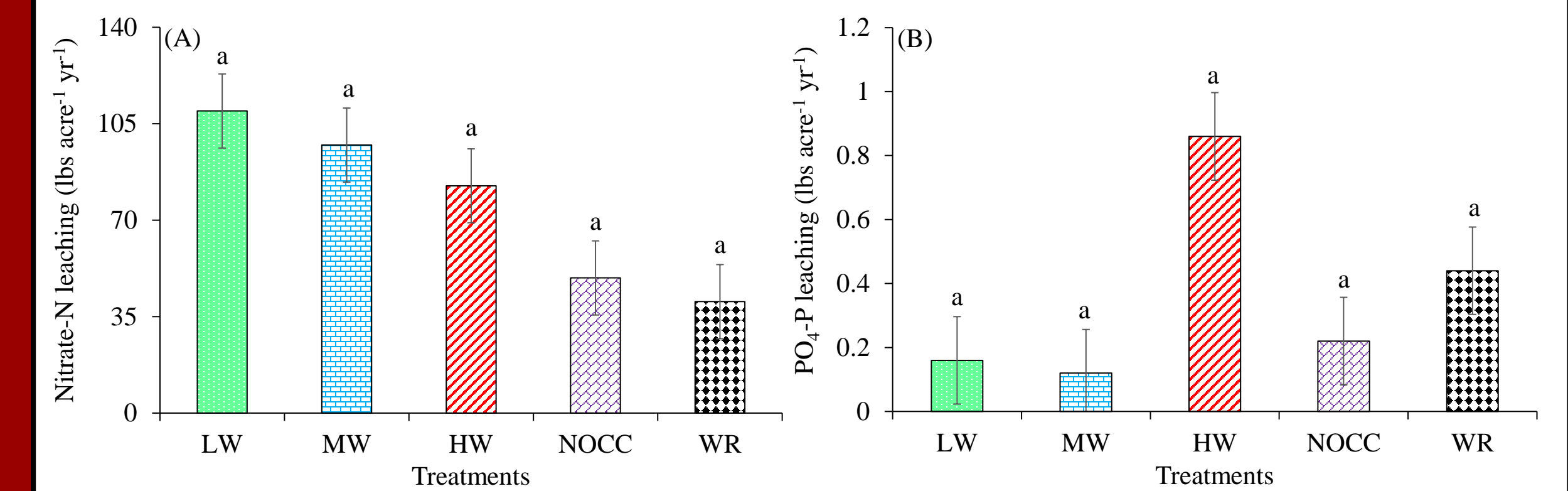


Fig. 4. Effect of treatments on nitrate-N leaching potential (A), and P-leaching potential (B) in wheat growing season at the BRC site.

Soybean Yield, N and P Leaching, and Yield-Scaled N Leaching Potential (BRC)

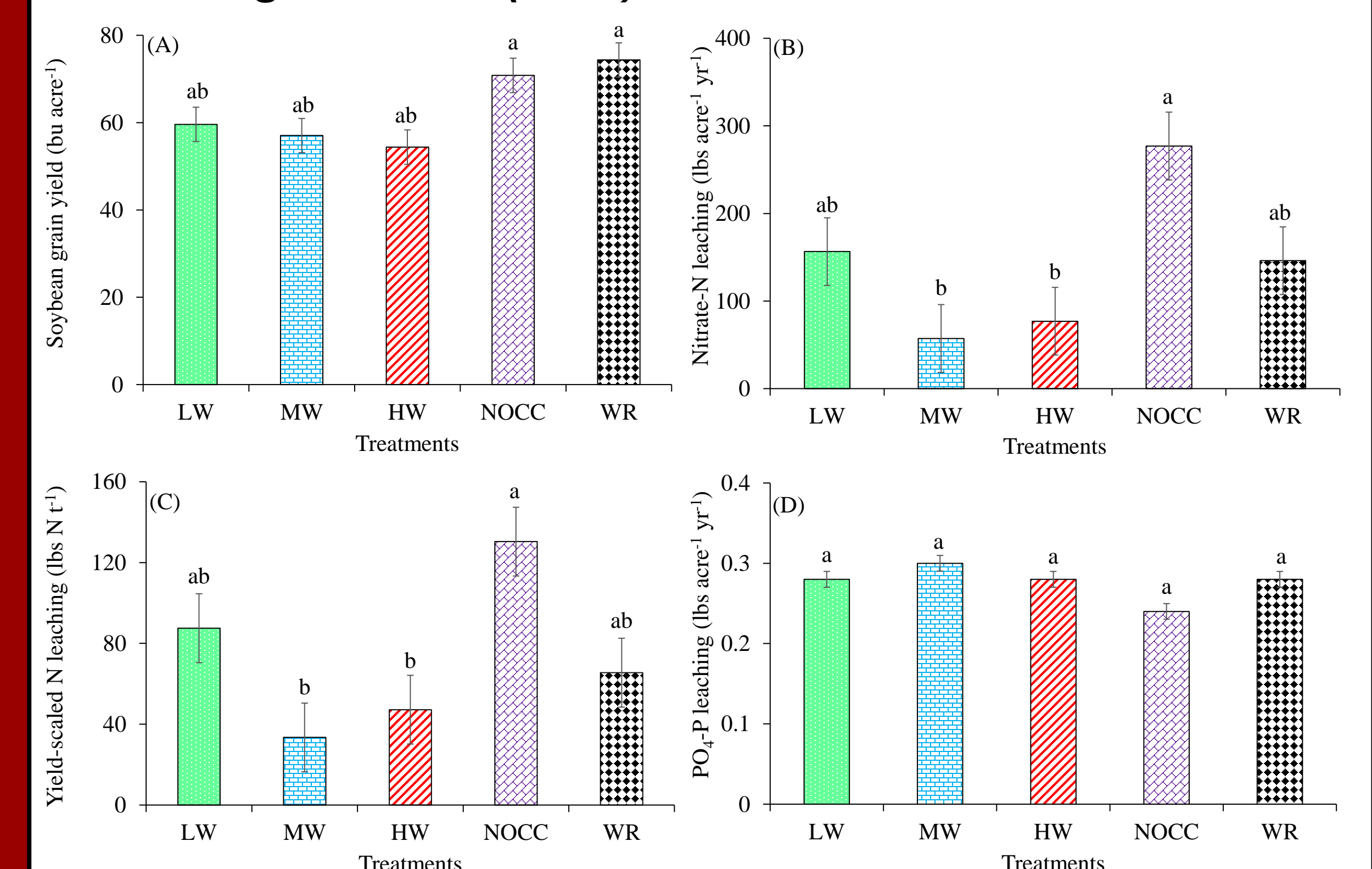


Fig. 5. Effect of treatments on yield (A), nitrate-N leaching potential (B), yield-scaled N leaching potential (C), and P-leaching potential (D) in soybean at the BRC site.

Cumulative N and P Leaching in Wheat and Soybean (BRC)

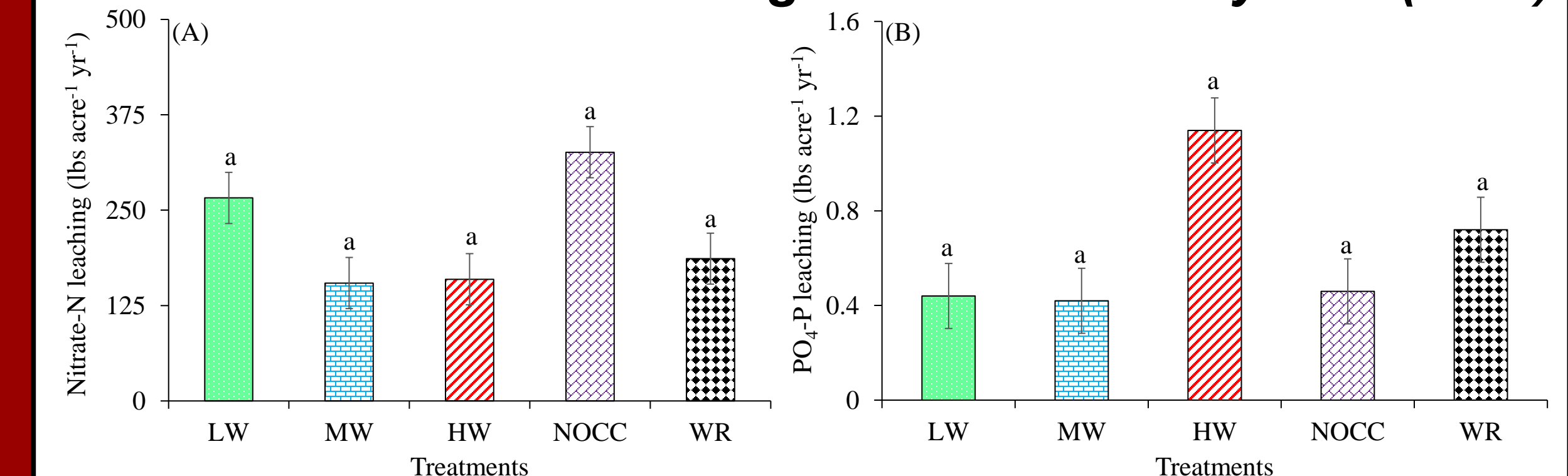


Fig. 6. Effect of treatments on nitrate-N (A) and PO₄-P (B) leaching potential at the BRC site.

Preliminary Conclusions

- Low N intensity management during wheat phase resulted in almost 30% less wheat biomass at ARC and BRC. Grain yield for wheat followed its biomass trend with medium and high intensity N management resulting in higher grain yields.
- In wheat, nitrate-N leaching was higher in the no-CC treatment than CR.
- Nitrate-N leaching during the soybean year was higher in the no-CC treatment indicating wheat or CR prior to soybean result in nitrate-N leaching reduction.
- Cumulative nitrate-N leaching indicated nitrate-N loss was decreased by double cropping compared to a no-cover crop control.

References

- IL NLRs (Illinois Nutrient Loss Reduction Strategy). (2015). Illinois Nutrient Loss Reduction Strategy. Springfield, IL: Illinois Department of Agriculture and Illinois Environmental Protection Agency. <https://www2.illinois.gov/epa/Documents/epa/water-quality/watershed-management/nlrs/nlrs-final-revised-083115.pdf>.
- Tsiboe, F., Popp, J.S. and Brye, K.R. (2017). Profitability of alternative management practices in a wheat-soybean, double-crop production system in Arkansas. *Agron. J.* 109(5), 2149-2162. doi.org/10.2134/agronj2017.03.0140