



# Investigating soil carbon and nitrate dynamics under varying tillage and cover crop management systems to reduce nitrate loss

Bri Gates, Michael Douglass, Lowell Gentry, Eric Miller, Kato Ssentamu, Ronnie Chacón, Andrew Malcomson, Andrew Margenot

Department of Crop Sciences, College of Agricultural, Consumer and Environmental Sciences, University of Illinois at Urbana-Champaign

## Rationale

Can nitrogen (N) immobilization be managed to reduce nitrate losses and avoid yield penalties? Winter cover crops and conservation tillage can impact N mineralization and loss directly and indirectly via soil carbon (C) dynamics.

## Objective

Evaluate treatment effects from various tillage intensities and cover crop systems on cash crop yield, N and C cycling to determine if reduced tillage and a cover crop system can reduce annual nitrate leaching, increase soil C, and maintain yield.

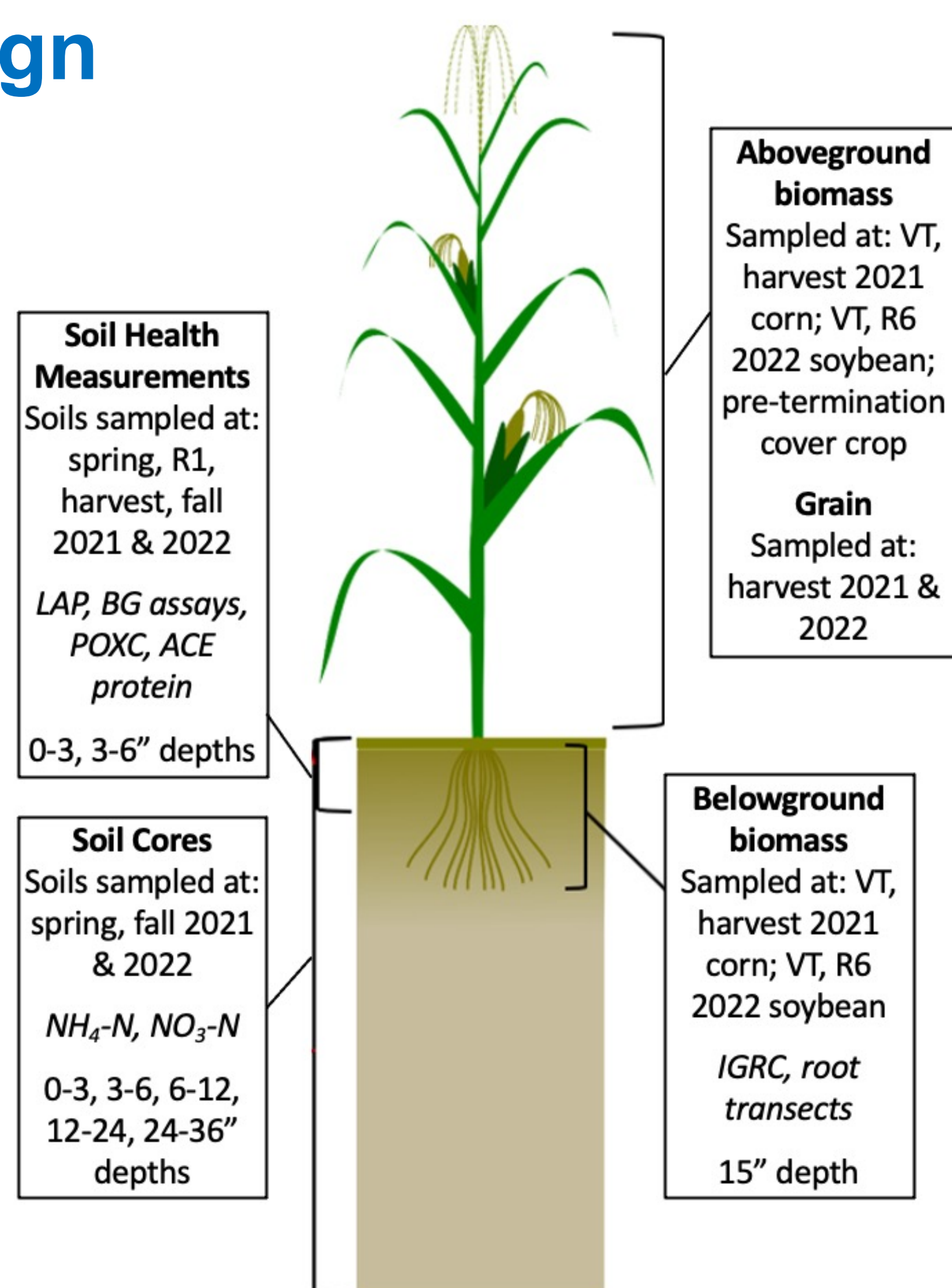
## Questions

- How do tillage and/or cover cropping impact soil nitrate-N to tile line at approximately 36" depth?
- If nitrate is used by a cover crop when it is most vulnerable to being lost, can this reduce annual nitrate loss *and* avoid corn/soybean yield loss?
- Do N and C cycling soil health indicators respond to cover cropping and/or conservation tillage practices?

## Experimental Design & Methods

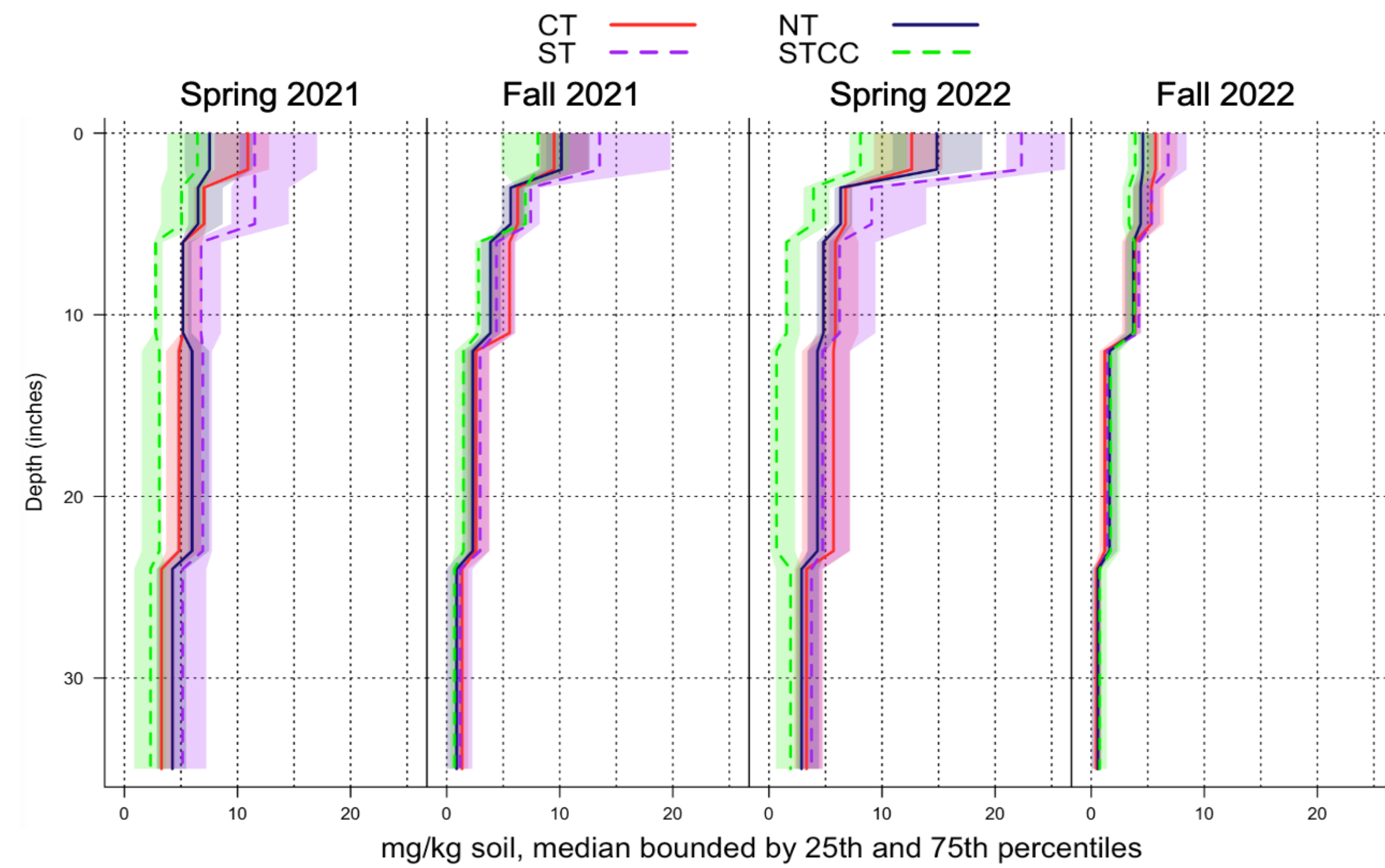
Randomized Complete Block Design  
44-acre field in Piatt Co.

- 4 treatments x 4 replicate blocks on 16 tile-drained plots; 2 subplots per replicate
- Chisel-till (CT)
  - No-till (NT)
  - Strip-till (ST)
  - Strip-till + cover crop (STCC)



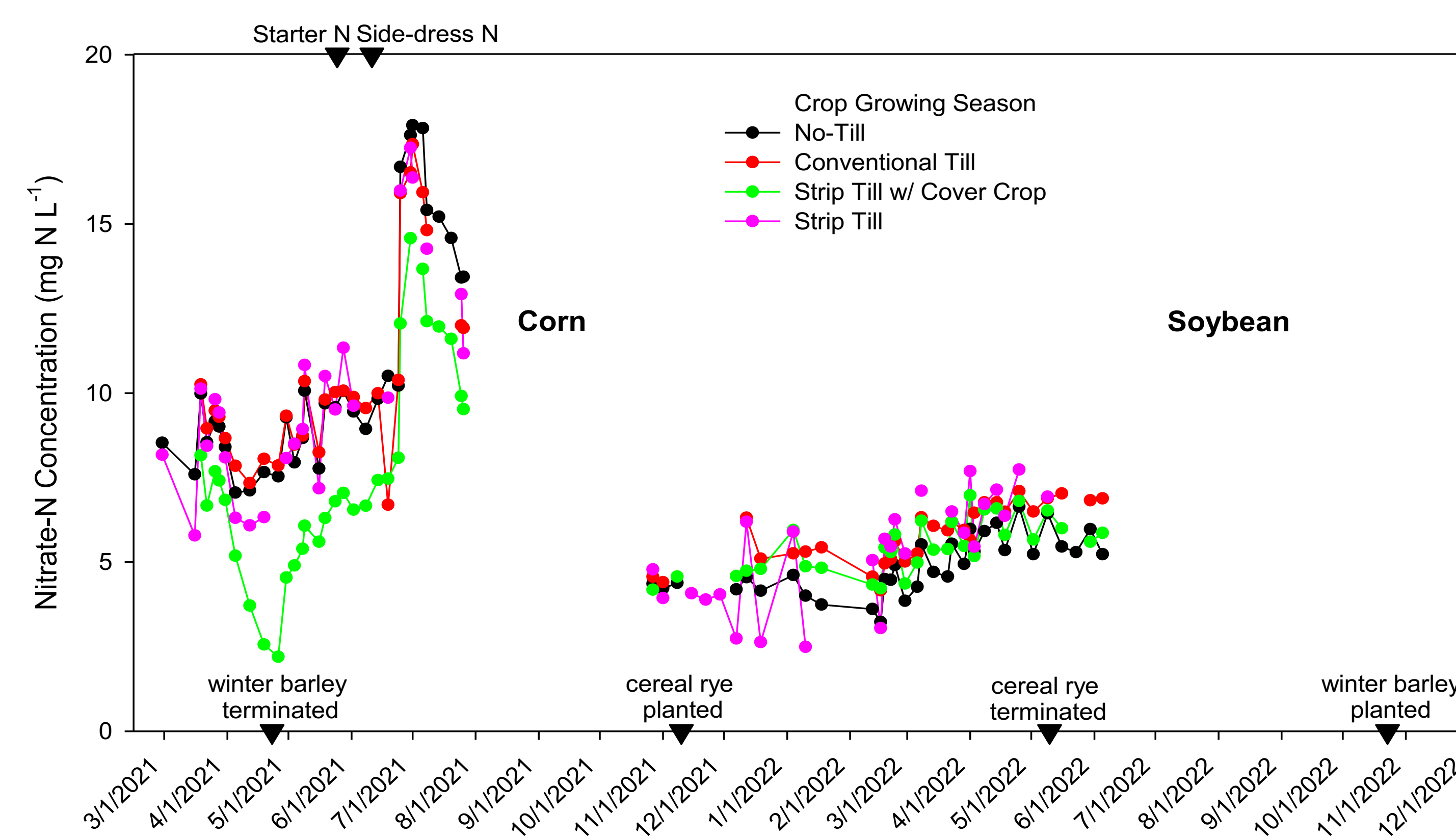
## Results

### Soil nitrate-N concentrations



- Soil nitrate-N lowest in all depths from spring '21 to spring '22
- Soil nitrate-N reduced to 6" in fall '22 in STCC treatment

### Tile nitrate-N concentrations



- Tile nitrate-N reduced by 25% in spring 2021 STCC
- Unaffected by treatment in 2022

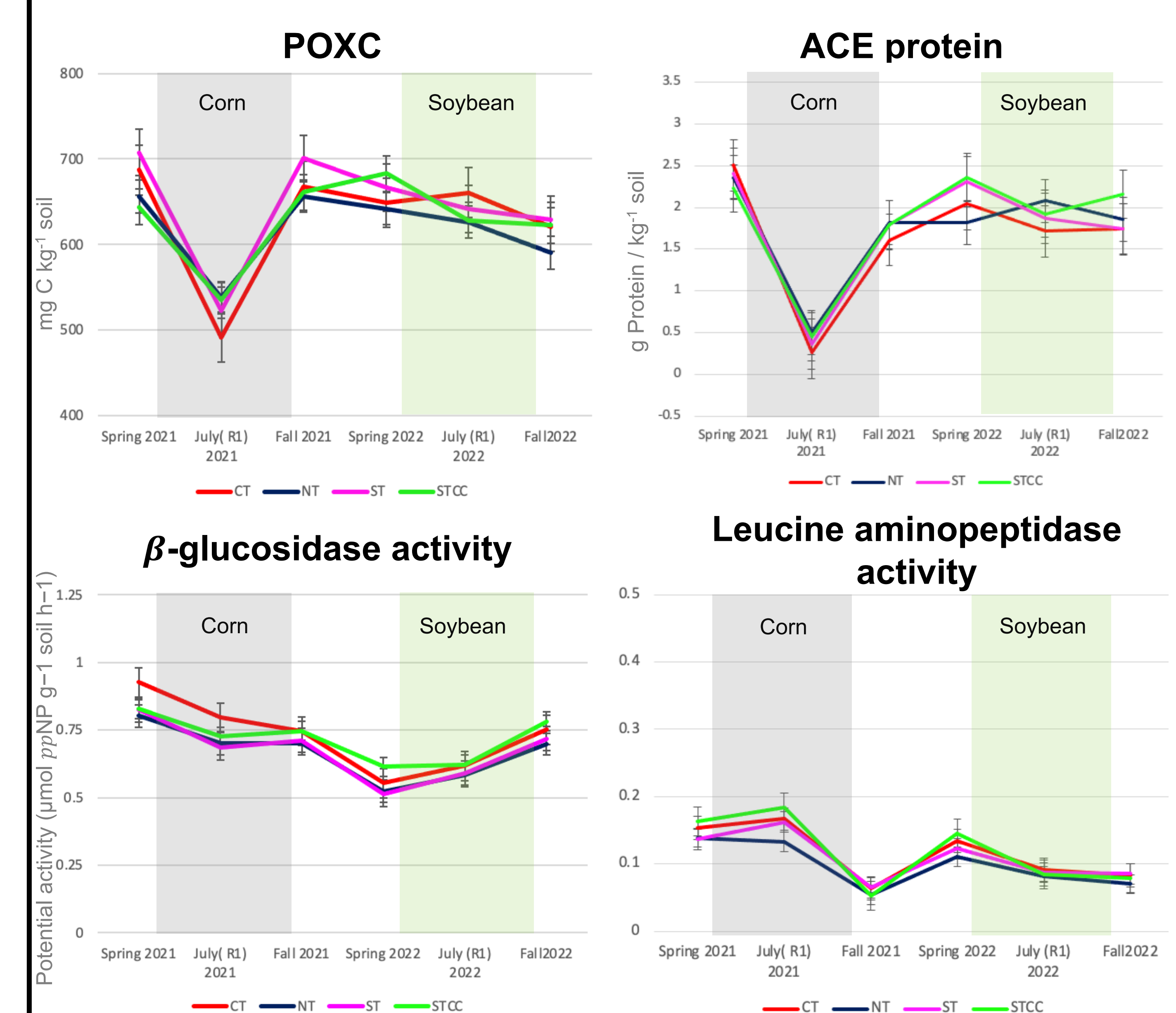
### Crop yield

Treatment	2021 Corn Yield (bu/A)	2022 Soybean Yield (bu/A)
Chisel-till (CT)	248.3 ± 3.98 <sup>a</sup>	84.4 ± 1.6 <sup>a</sup>
No-till (NT)	256.5 ± 2.22 <sup>a</sup>	83.9 ± 1.2 <sup>a</sup>
Strip-till (ST)	256.3 ± 3.47 <sup>a</sup>	83.4 ± 3.1 <sup>a</sup>
Strip-till + cover crop (STCC)	250.5 ± 3.20 <sup>a</sup>	83.3 ± 1.2 <sup>a</sup>

- No yield differences for corn or soybean

## Results

### Soil health measurements



- POXC decreases by 25% at R1 corn in 2021
- ACE decreased by 83% at R1 corn in 2021
- BG activity decreases through 2021, increases in 2022
- LAP decreases through fall of both years
- No treatment effects observed for any SHIs

## Summary

- Cover crop uptake successfully decreased soil nitrate-N in spring of 2021 and 2022
- Tile nitrate-N 25% lower in spring 2021. No treatment affect observed in spring 2022, but could be due to dry weather conditions
- No yield loss from cover crop in 2021 corn or 2022 soybean
- No treatment affects observed on SHIs 2021 through 2022; tested SHIs may not be sufficient indicators of N and C cycling



### Acknowledgements

This work is generously supported by Illinois Nutrient Research and Education Council (NREC) Award # 2021-4-360350-257