

# Effects of Drainage on Crop Yield, Drainage Volume, Nitrate Loss, and Water Table, in Southeast Iowa

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## Introduction and Rationale

Subsurface drainage removes excess water from agricultural land especially during the rainy spring months when the timeliness of field operations are important. It also short circuits nitrate export downstream, causing negative environmental impacts.

The objective of this study was to determine the impact of shallow drainage (SH), controlled drainage (CD), conventional drainage (Conv.), and no drainage (ND) on crop yields, depth to water table, subsurface drainage volumes, and nitrate loss through subsurface drainage.

## Experimental Procedure

This research was conducted at the Iowa State University Southeast Research Farm (SERF) located near Crawfordsville, Iowa. Each plot is planted so half is in corn and half is in beans every year. There are two replications for each drainage treatment.

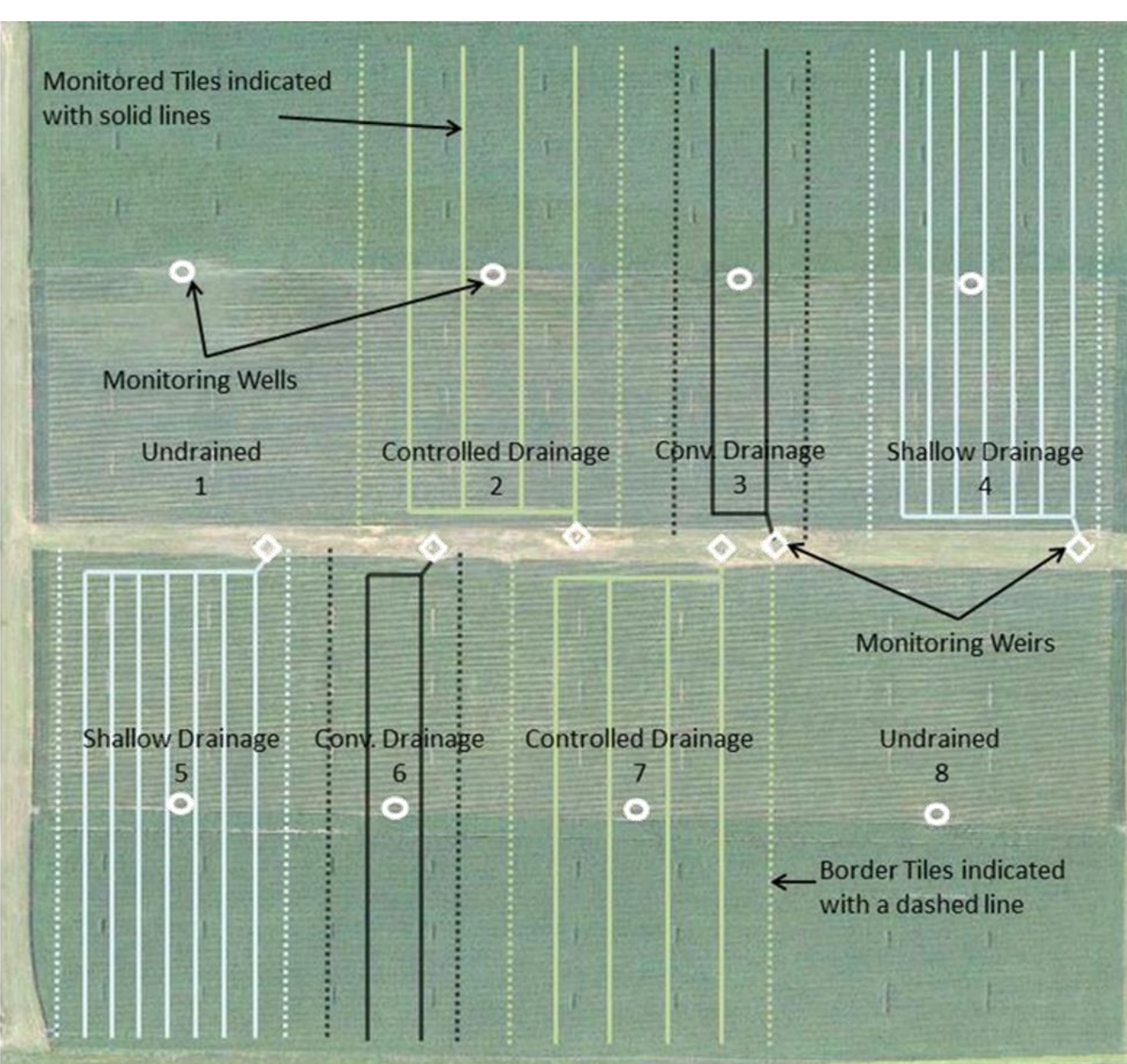
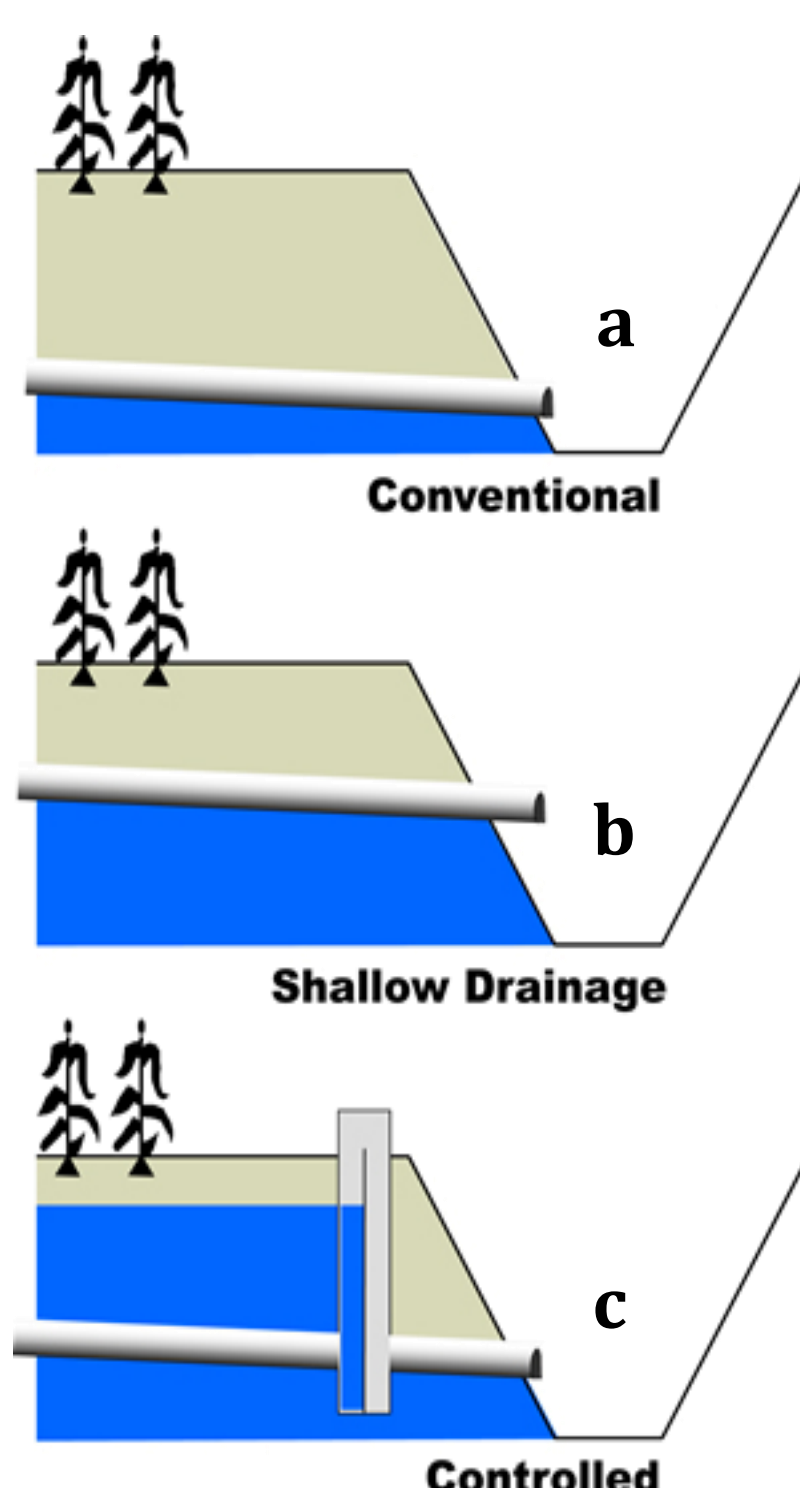


Figure 1: Drainage plot layout at SERF showing border tiles, monitoring wells, monitoring weirs, and crop rotation.

## Drainage Treatments

Figure 2: Drainage at SERF

- Conv. tile is installed 1.2 m deep with 18 m spacing.
- SD tile is installed 0.76 m deep with a 12.2 m spacing.
- CD tile is identical to DD, but there is a control structure for water table height regulation. During planting, the water table is maintained at tile depth but is kept higher (0.76 m) during the growing season if there is enough rain after planting.



## Results and Discussion

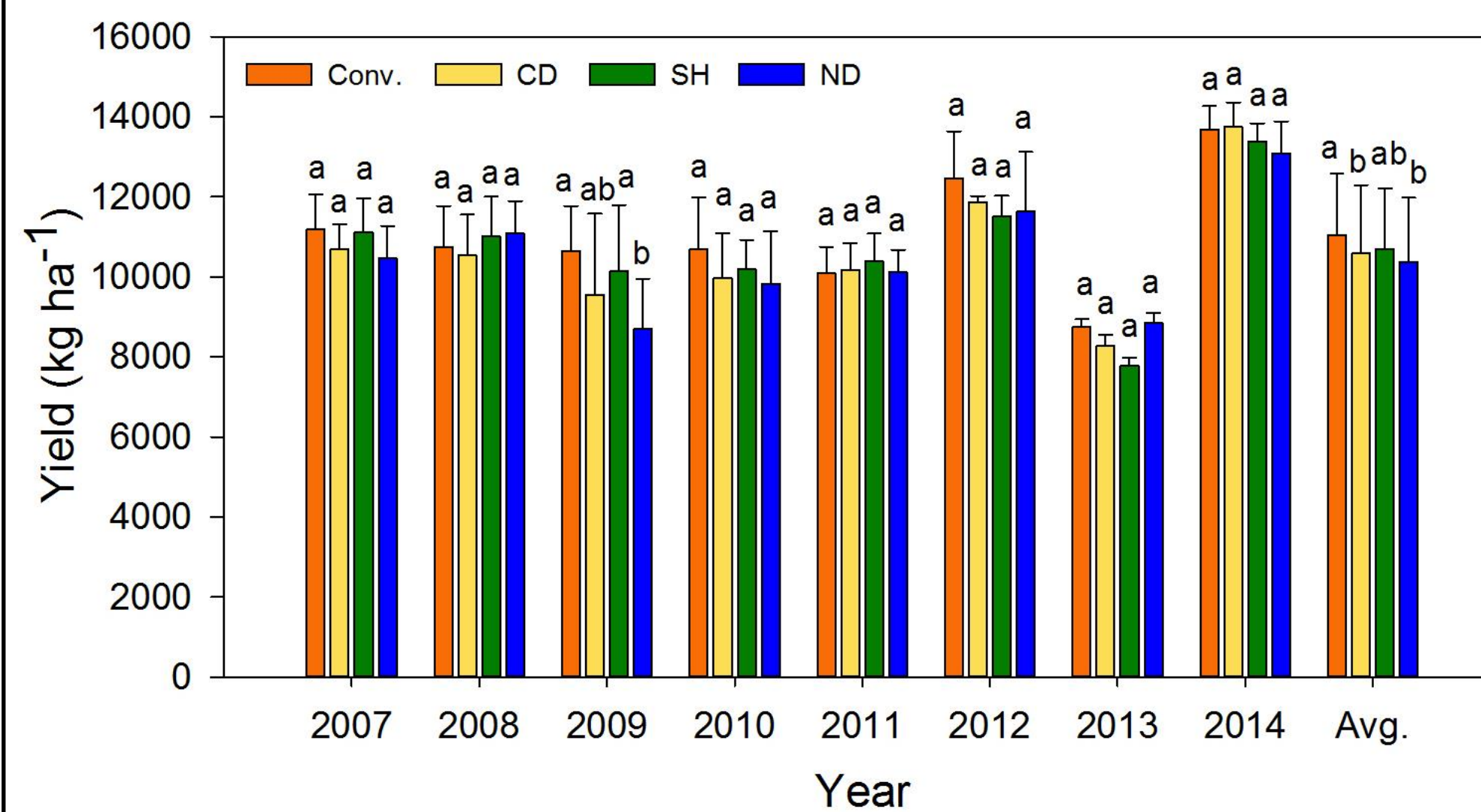


Figure 3: Average annual corn yields. Bars within years with different letters are statistically different ( $p < 0.05$ ).

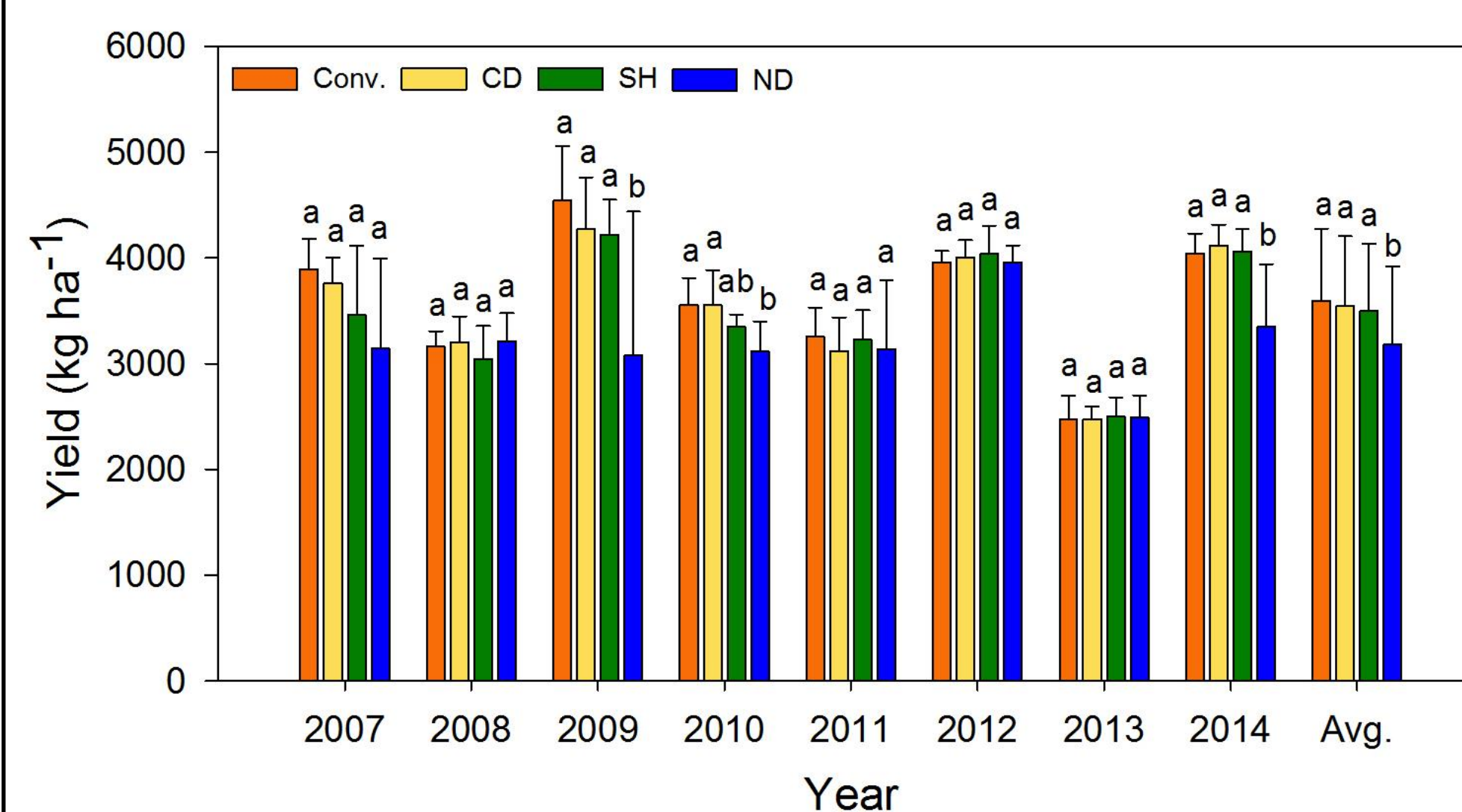


Figure 4: Average annual soybean yields. Bars within years with different letters are statistically different ( $p < 0.05$ ).

	Conv.	CD	SH	ND
2010	36	5	0	874
2011	4	0	0	60
2012	20	23	33	152
2013	7	25	182	524
2014	0	3	73	291
Avg.	13	11	57	380

Table 1: Number of hours during the growing season (Apr. – Oct.) when the water table is within 30 cm of the ground surface.

### Yields

- Conv. corn yields were greater by 3% than SH, 4% than CD, and 6% than ND.
- ND reduced soy yields by 13%, but yields were within  $100 \text{ kg ha}^{-1}$  for all three drained treatments.

### Drainage and Water Quality

- SH reduced drainage volumes by 51% and CD by 45% compared to Conv.
- $\text{NO}_3\text{-N}$  concentrations were the same for Conv. and CD ( $10 \text{ mg L}^{-1}$ ) but greater in SH ( $13 \text{ mg L}^{-1}$ ).
- For  $\text{NO}_3\text{-N}$  loads, CD reduced loads by 49% and SH by 42% compared to Conv.

### Water Table

- On average, year round the water table was the shallowest in ND followed by SH, CD, and Conv.
- ND has the greatest number of hours the water table is within 30 cm of the ground, potentially negatively impacting crop production.

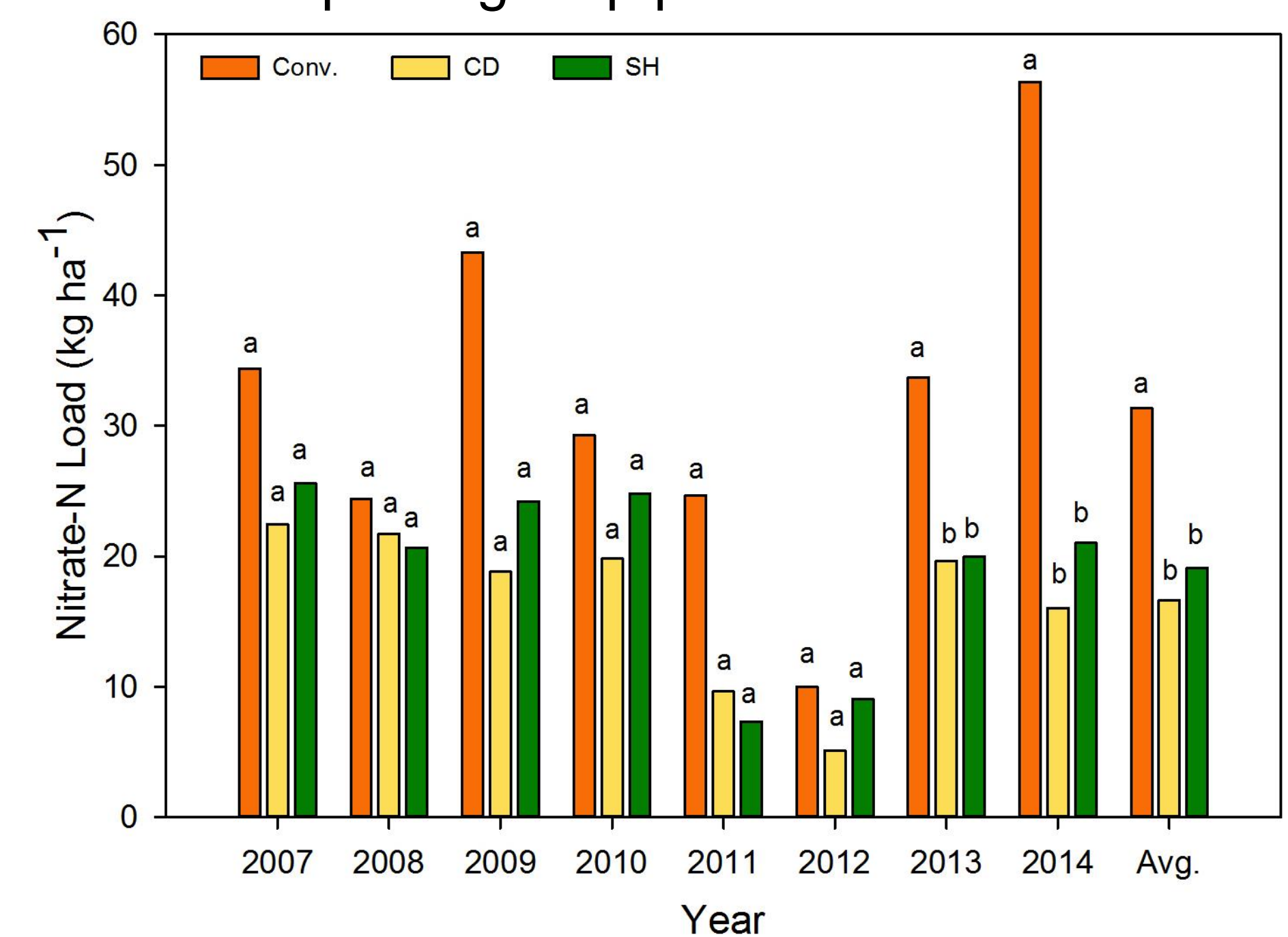


Figure 5: Annual  $\text{NO}_3\text{-N}$  loads. Bars within years with different letters are statistically different ( $p < 0.05$ ).

## Conclusions & Recommendations

- Since SH and CD reduce nitrate loads, both can be recommended to farmers as part of the nutrient reduction strategy.
- SH and CD shouldn't be recommended to decrease  $\text{NO}_3\text{-N}$  concentrations.
- CD corn yields were reduced, likely due to slower water table recession after big rain events.
- Although SH had a shallower water table than CD, yields were not reduced.
- Drainage increased yields, especially during wet years.

### Acknowledgements

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