

Timing of Nitrogen Supply from Spring Terminated Red Clover

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Introduction

- Overwintered cereal rye mixed with frost-seeded red clover may be a beneficial addition to the corn-soybean rotation that dominates row-crop production in the Midwest.
- Spring termination of red clover is of interest to farmers, as it extends the period that soil is covered with a living crop, and may increase N fixation.
- It is unknown how spring terminated red clover influences soil N cycling and the timing of the available N supply for a following corn crop: N availability may be limited early in the growing season if N is tied up, but late season availability may be increased as plant available N is released from clover biomass.
- The objective of this research was to investigate the timing of the N supply to a corn crop following spring terminated red clover.



Methods

- Two on-farm experiments located in Iowa (Sieren farm in Washington County and Sloan farm in Buchanan County) compared corn following spring terminated red clover to corn with a conventional N management strategy in the 2014 growing season.
- Red clover was under-seeded beneath a cereal crop that was harvested for grain. Red clover grew after rye until termination by herbicide the following spring. Crop management details are in Table 1.
- Corn plant N content was measured at two dates, and rate of N release from organic matter was measured by gross N mineralization (¹⁵N pool dilution) and potentially mineralizable N at the early date from the 0-30 cm depth.

Table 1

Crop management in the two treatments at the two farms in 2014.								
Farm	Treatment	Preceding crop	Red clover termination	Corn Planting	Pre-plant N rate (lb/ac)	Side-dress fertilization	Side-dress N rate (lb/ac)	Total N rate
Sieren	Red clover	Rye/red clover	April 23	May 6	23	--	0	23
	Synthetic N	Rye alone	--	May 6	113	June 12	77	190
Sloan	Red clover	Rye/red clover	May 18	May 21	27	--	0	27
	Synthetic N	Soybean/rye	--	May 21	27	June 14 & July 8	110	137

Results & Conclusions

Table 2

Corn yields in the two treatments at the two farms in 2014.		
Farm	Treatment	Corn yield (bu/ac)
Sieren	Red clover	150
	Synthetic N	199
Sloan	Red clover	127
	Synthetic N	179

Table 3

Change in total plant N between the early and late sampling times for both treatments at both farms.				
Farm	Treatment	Early sampling	Late sampling	Change
		----- Plant N (lb/ac) -----		
Sieren	Red clover	104	143	39
	Synthetic N	160	183	23
Sloan	Red clover	69	123	54
	Synthetic N	111	155	44

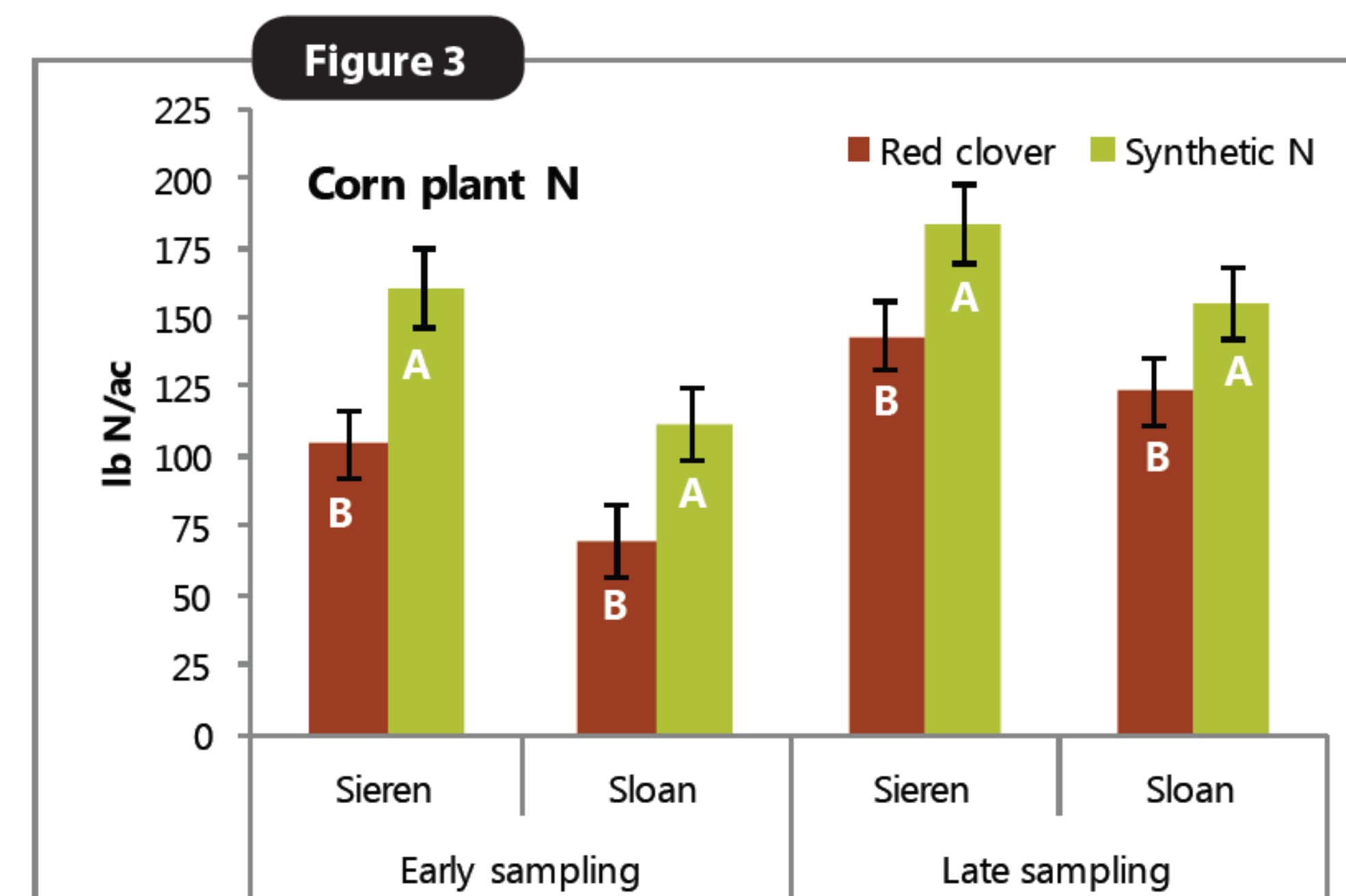


Figure 3. Total corn plant N content. Early sampling was first week of Aug. and late sampling was in late Sept. (Sieren) or Oct. (Sloan). The statistical analysis showed that sites were different (Sieren > Sloan) and the dates were different (Late sampling > early sampling). By farm and sampling date, columns with different letters are significantly different. Error bars represent standard error of the mean.

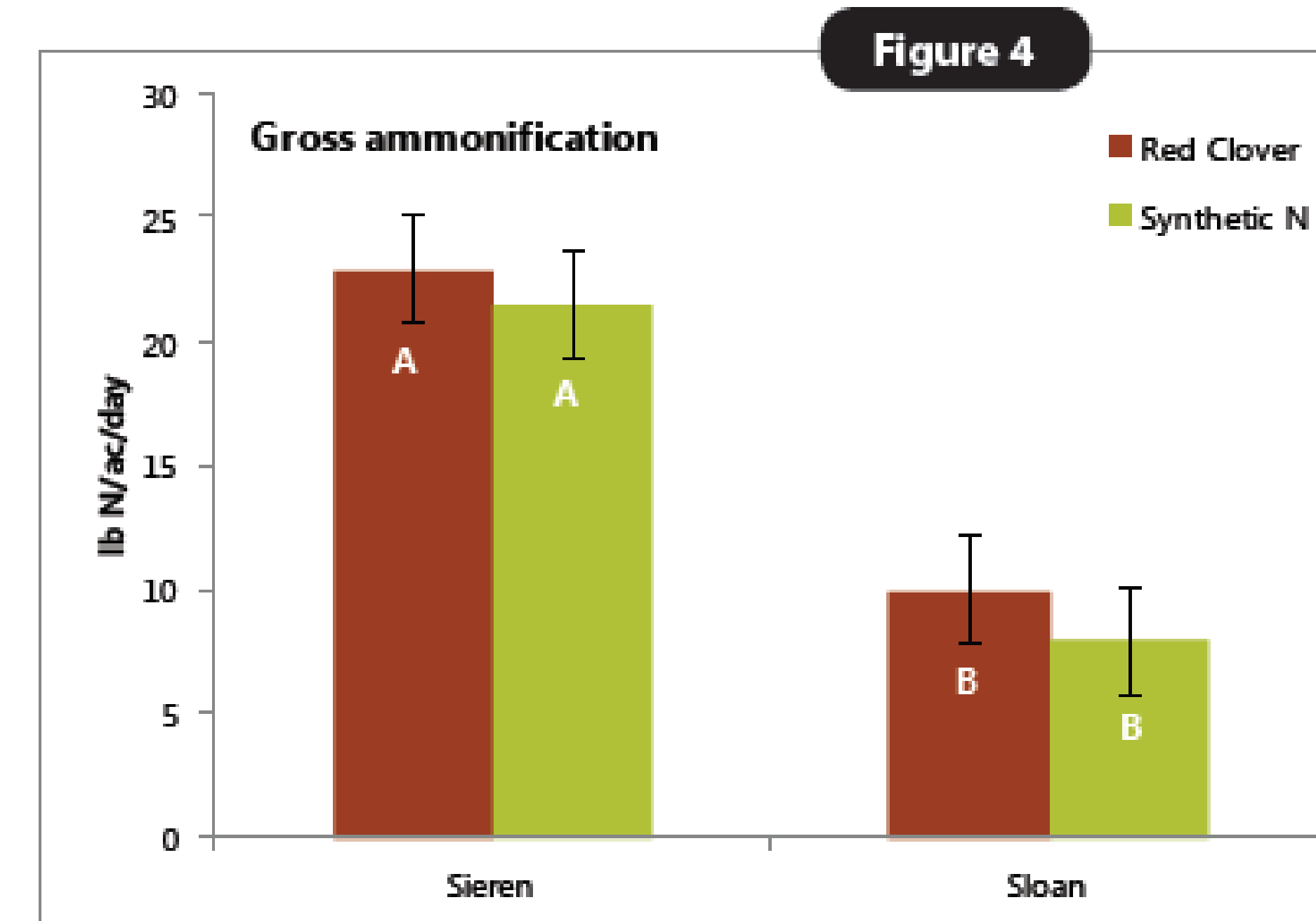


Figure 4. Gross ammonification rate is a measure of the rate at which organic nitrogen is broken down to ammonium (NH₄⁺), and this rate was measured once during the first week of Aug. 2014. Gross ammonification was significantly different between the two sites (Sieren farm > Sloan farm), but did not differ by the treatment. Error bars represent standard error of the mean, and letters represent statistically different groups.

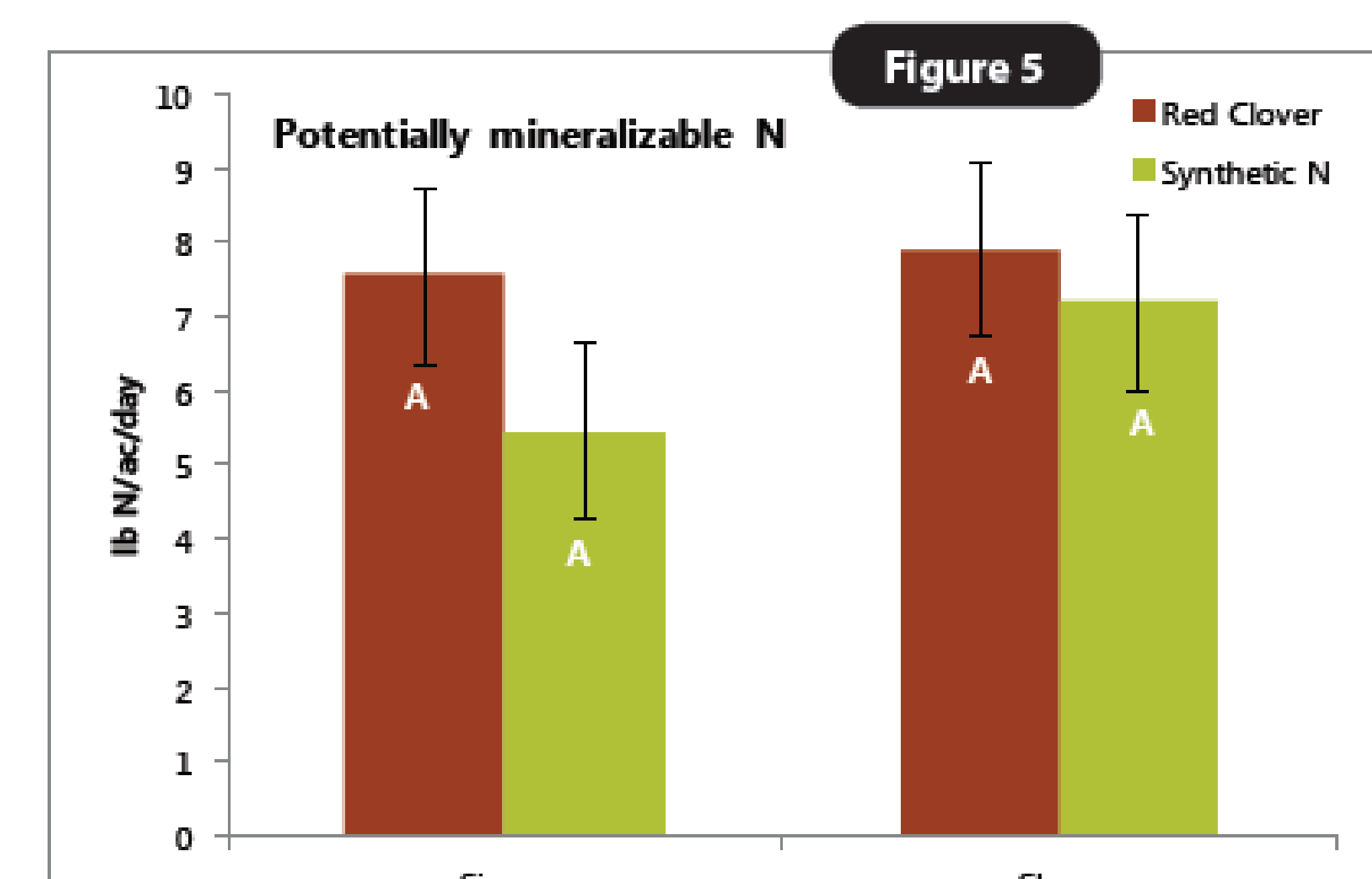


Figure 5. Potentially mineralizable N (PMN) is a measure of the accumulation of NH₄⁺ over a 7-day period in an anaerobic (saturated) soil sample. PMN was not significantly different between the two sites or the two treatments. Error bars represent standard error of the mean, and letters represent statistically different groups.

- Corn yields were lower following spring terminated red clover compared to a conventional N management strategy.
- Spring terminated red clover decreased corn N uptake early in the growing season but increased N uptake later in the growing season, suggesting that N limitation occurred only early in the growing season.
- We did not observe a significant effect of red clover on the rate of nitrogen release from soil organic matter, possibly due to variability in soil properties.
- Moderate supplemental N fertilizer could conceivably enable young corn plants to overcome the early N limitation and eliminate corn yield decreases following spring terminated red clover.
- Cereal rye mixed with red clover holds potential for diversifying corn-based cropping systems in Iowa, but further refinement is required.