Nitrogen Source and Rate Effects on Corn Yield and Economics in the Western Corn Belt

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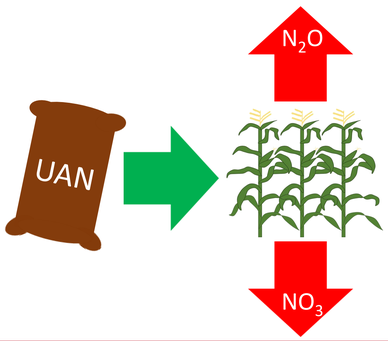
Background

- Nitrogen (N) plays an essential part in developing life on earth. It is used as a major building block in different organic components.
- Although N is critical for the life development in the world, it can also cause problems in the environment.
- Environmental concerns include an excess amount of N that could be released into the atmosphere and the groundwater.
- N can be released in the atmosphere as N_2O which is one of the greenhouse gases responsible for climate change.
- N can also be leached from the soil (NO_3) and contaminate surface and groundwater.
- A balance between corn yield, minimizing environmental risks, and economic profit for producers are required for a sustainable system.



Hypotheses

- Synthetic N fertilizer (urea ammonia nitrate, UAN) would produce a higher crop yield than manure fertilizer.
- A higher amount of N fertilizer (200 kg ha^{-1}) available in the soil would produce a higher crop yield than soils with smaller amounts of N fertilizer (125 kg ha^{-1}).
- A larger rate of manure treatment would give the farmer a larger profit.

Materials and Methods

- The South Central Agricultural Laboratory (SCAL) experimental study was established in 2010. (Clay Center, NE)
- Soil type at the SCAL study site is a Hastings silt loam (Mesic, Udic Argiustolls).
- The experiment is a continuous corn system that consists of four randomized replicates of manure and synthetic N fertilizer plots (125 kg N ha^{-1} and 200 kg N ha^{-1} amounts) under full irrigation.
- SCAL was a furrow-irrigated, ridge-tilled corn-soybean rotation system prior to study and was last disked in April 2010.
- Data presented is from 2011 to 2017.
- Data was analyzed using SAS 9.3 where anything less than or equal to 0.05 was considered significant.
- Price of corn was $5.00/bu.($0.197/kg)
- UAN price was $331/ton*1ton/907kg = (X*$0.36/kg) + $37.73
- Manure was $35/ton*1ton/907kg = (M*$0.04/kg) + $58.05

Table 1. Summary of Treatments Observed at SCAL. Manure applications were applied in even years.

N treatment	N Rate (kg ha^{-1})	N source (kg ha^{-1})	Placement	Application time
Manure	125	55 + 70 UAN	Surface	Fall
Manure	200	57 + 143 UAN	Surface	Fall
UAN	125	125 UAN	Knifed	Side-dress
UAN	200	200 UAN	Knifed	Side-dress

Figure 1. SCAL Map Location.
1a. Top left: Ariel image of the SCAL field.
1b. Center: Tractor spreading manure on plots.
1c. Top Right: Corn plants on treatment plots observed at SCAL.

Results and Discussion

- There was a significant difference in grain yield between the two N rates (Table 2).
- Grain yield was similar by N source (P = 0.8414) and the interaction between n source and N rate (P = 0.8880).

Table 2. Analysis of variance results of corn yield on N rate (125 or 200 kg ha^{-1}) and N source (manure or UAN).

Effect	Den DF	Significance (P-value)
N rate	108	0.0002
N source	108	0.8414
N rate x N source	108	0.8880

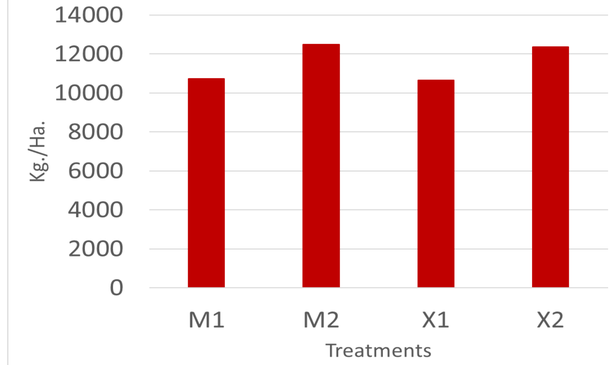


Figure 2. Grain yield averages of Manure (M) and UAN (X) under two N rates (1 = 125 kg ha^{-1}; 2 = 200 kg ha^{-1})

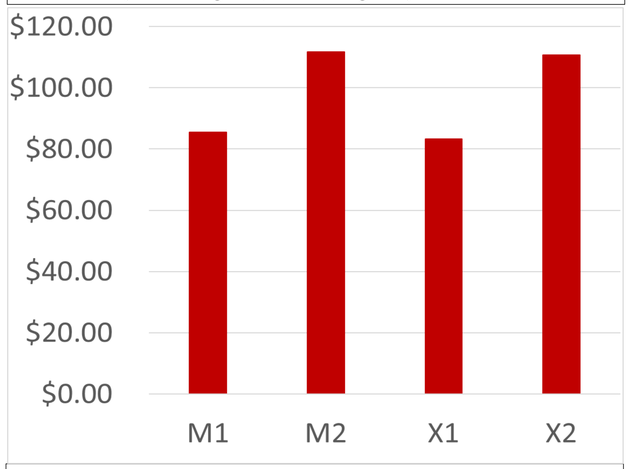


Figure 4. Total expenses from the four treatments.

Revenue from the four treatments

- M1 = 10,723 kg/ha * $0.197/kg = **$2,112.43/ha**
- M2 = 12,479 kg/ha * $0.197/kg = **$2,458.36/ha**
- X1 = 10,660kg/ha * $0.197/kg = **$2,100.02/ha**
- X2 = 12,353kg/ha * $0.197/kg = **$2,433.54/ha.**

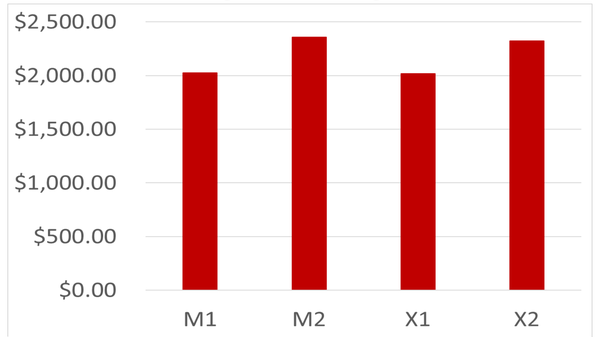


Figure 3. Profits of the four treatments subtracting expenses from revenue.

Conclusion

The data provided supports the following conclusion:

- Manure treated fields produced a slightly higher crop yield when compared to Synthetic N, but there is no significance in the different sources.
- The 200kg/ha^{-1} N rates produced higher corn yield than the 125kg/ha^{-1} rate.
- The N treatment at 200kg/ha^{-1} received a larger rate of manure gave the largest profit to the farmer.

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