Effect of Irrigation and Nitrogen Rates on Yield of Corn for Silage

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Introduction

- In arid and semi-arid regions, proper irrigation and nitrogen (N) management strategies are required to achieve top yield and high quality of corn for silage (Cox et al. 1993).
- To maximize corn silage production, N and irrigation water requirements can be determined by N rates and irrigation scheduling.

Objectives

To determine the best combination of N rates and irrigation water amount under sprinkler, on-surface drip (ODI), and sub-surface drip (SDI) irrigation systems to maximize corn silage yield.

Materials and Methods

Location:

The University of Wyoming Research and Extension Center located in Powell, WY (Picture 1).

Plant material:

The hybrid Pioneer 'P8107HR'.

Treatments:

Irrigation was the main treatment calculated using a time varying crop coefficient (Kc) multiplied by a reference Evapotranspiration (ET_0). The N rates were the sub-treatments.

- **Sprinkler study (2013):**
  - Four irrigation treatments [100, 80, 60, and 50% of crop evapotranspiration (ETc)] were applied.
  - There were three N treatments: N1=75, N2=130, and N3=200 kg N ha^{-1}. N1 was applied at planting, N2 was applied in 2-split applications (at planting and V5 growth stage) and N3 was applied in 3-split applications (at planting, V5, and V8 growth stages).
- **SDI and ODI studies (2014):**
  - Three irrigation treatments [100, 80, and 60% ETc] were applied.
  - Five N rates (0, 90, 180, 270, and 360 kg N ha^{-1}) were applied (2- to 4-split applications at planting, V4, V8, and V10 growth stages).

Experimental design:

- Sprinkler study: A randomized complete block in a split-plot arrangement with three replications.
- SDI and ODI studies: A completely randomized design in a split plot in space with four replications for the SDI and three replications for the ODI.
- Data was analyzed using the SAS statistical program.

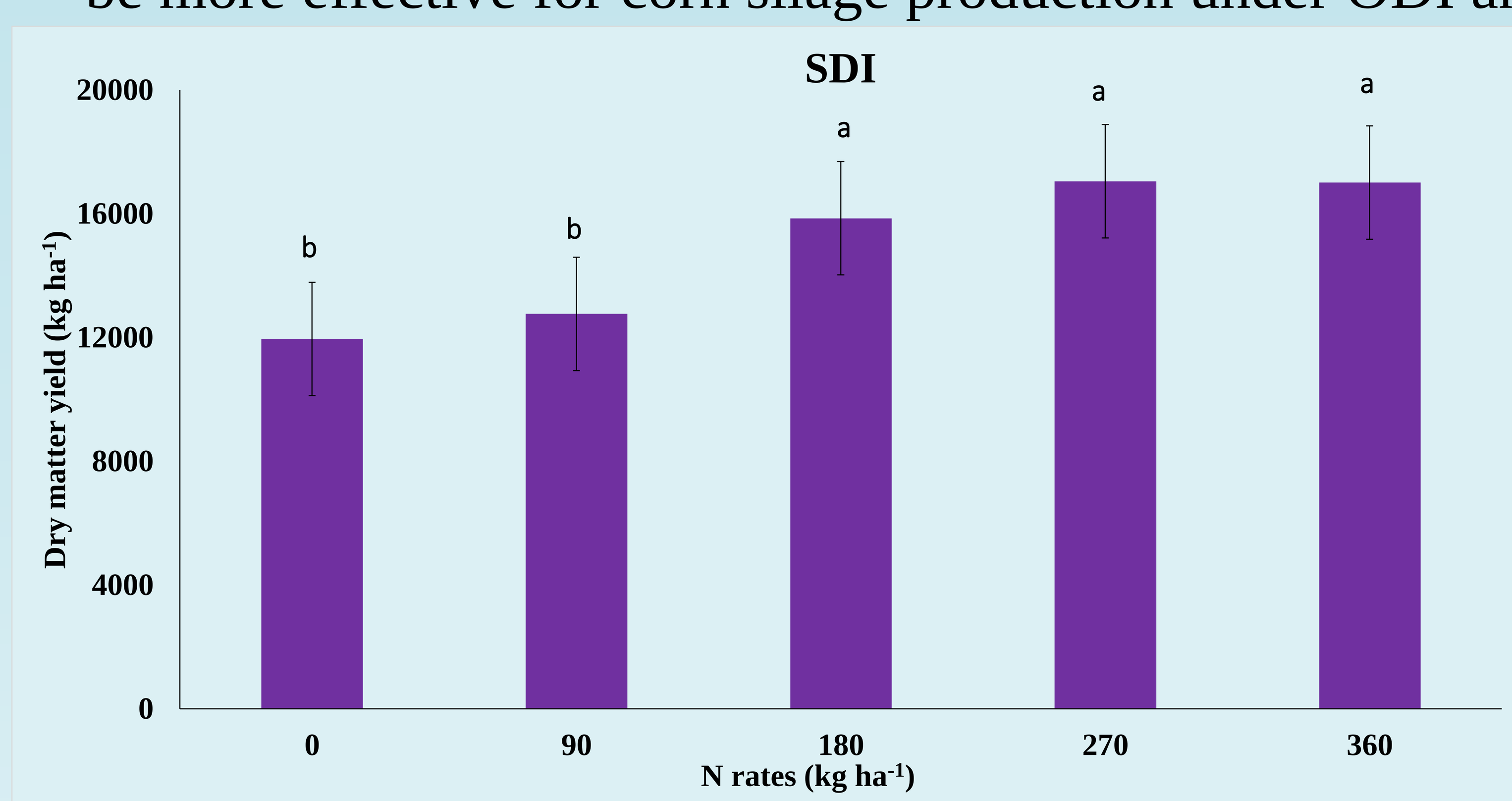
Results and Discussion

- **Sprinkler irrigation system:**
  - Among the irrigation levels, 100ETc produced the maximum corn silage yield, however, it was not different from 80ETc, while 60ETc and 50ETc produced the lowest yield (Table 1) clearly indicating that 80ETc would be more productive and profitable since it could save 20% of water use.
  - Nitrogen did not affect corn silage yield (data not shown). This was probably due to the residual N in the soil from previous crop cultivation.
- **SDI and ODI systems:**
  - The irrigation level 100ETc produced the maximum yield. No difference was observed between the 100ETc and 80ETc treatments. The 60ETc produced the lowest yield (Table 1). As a consequence, 80ETc might be used for both irrigation systems for higher corn silage production.
  - Within irrigation systems, N affected corn silage yield. The 270 kg N ha^{-1} produced the maximum yield, however, it was not different from 180 kg N ha^{-1} (Figure 1). Therefore, a rate between 180 and 270 kg N ha^{-1} might be more effective for corn silage production under ODI and SDI systems.

Table 1. Yield of corn for silage at different irrigation treatments

Irrigation treatment	Yield (kg ha^{-1}) *		
	Sprinkler-2013	SDI- 2014	ODI-2014
100ETc	17,299 A	16,130 A	16,994 A
80ETc	16,646 A	16,076 A	15,241 A
60ETc	11,121 B	12,582 B	10,734 B
50ETc	10,638 B	.	.
LSD (0.05)	3,165	1,535	3,525

*Within column, means with the same letter are not significantly different at α=0.05



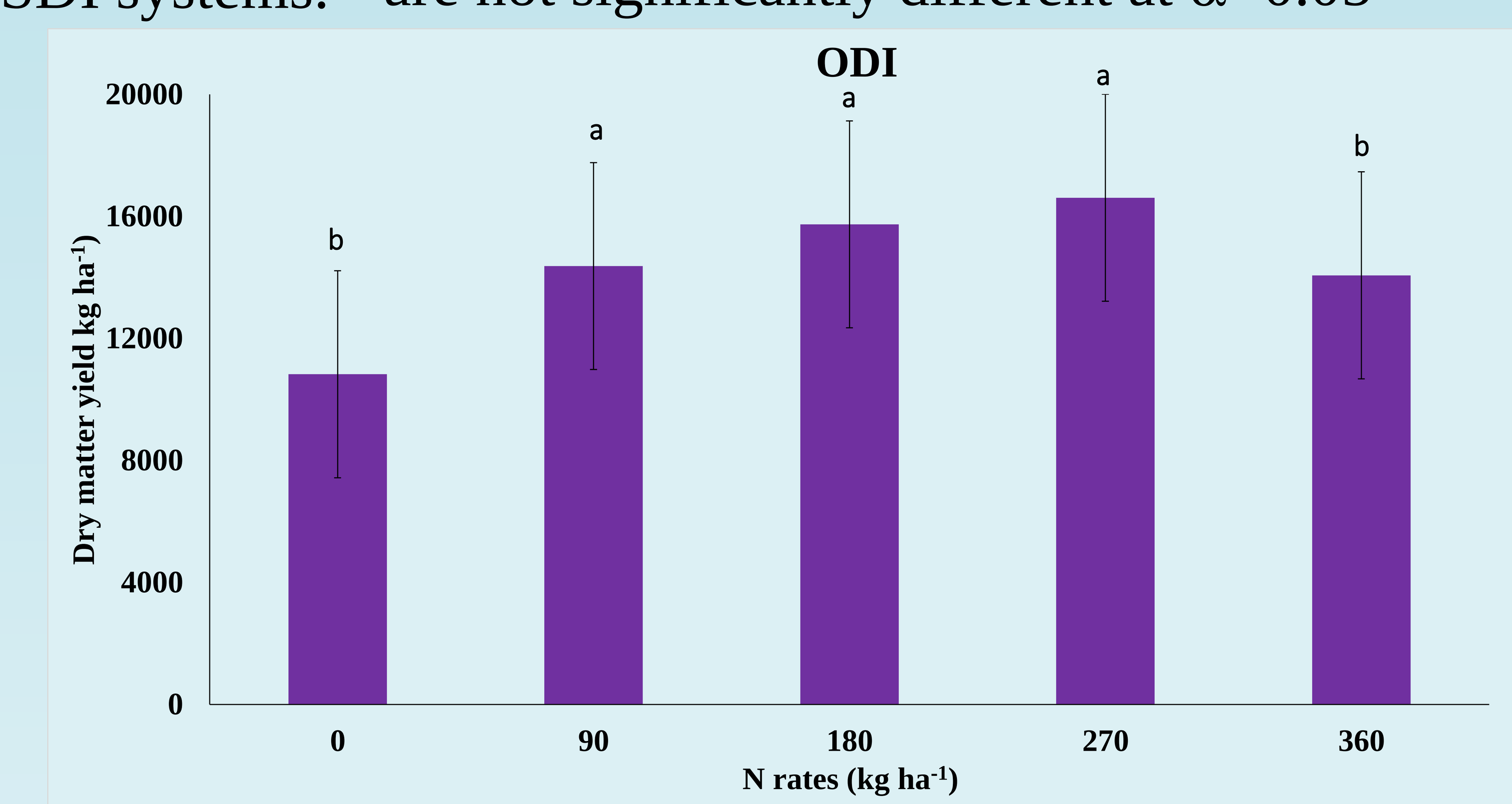
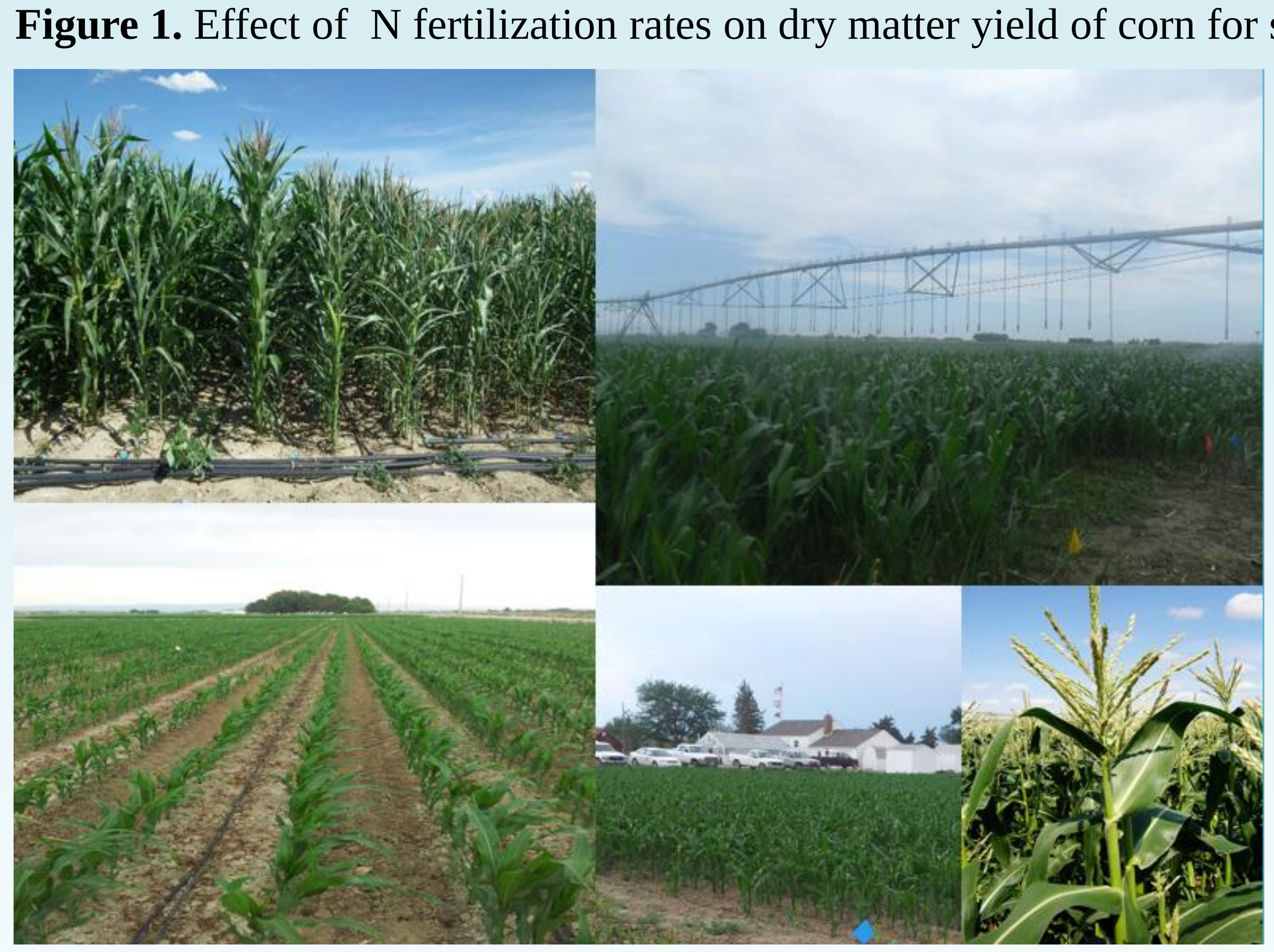


Figure 1. Effect of N fertilization rates on dry matter yield of corn for silage under sub-surface drip (SDI) and on-surface drip (ODI) irrigation systems.



Picture 1. Corn for silage under sprinkler, on-surface drip and sub-surface drip irrigation systems.

Conclusion

- The irrigation level 80ETc under sprinkler, SDI, and ODI seemed to have potential for beneficial corn silage production without compromising any yield loss.
- At least 180 kg N ha^{-1} might be needed to make the corn silage production beneficial under SDI and ODI systems.

Acknowledgments

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References

Cox, W.J., S. Kalonge, D.J.R. Cherney, and W.S. Reid. 1993. Growth, yield, and quality of forage maize under different nitrogen management practices. *Agronomy Journal* 85, 341–347.