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

A. Nilahyane¹, M.A. Islam¹, and A.García y García¹,*

Corn for silage requires adequate amounts of water, nutrients, and good management practices for profitable production. Corn has been reported to have high irrigation requirements; however, the great challenge is to increase productivity with less water use.

Nitrogen (N) is required in large amounts and is one of the best crop-input investments for corn production, but N is the most expensive nutrient for farmers. Thus, best management practices for N—including use of proper application rates, appropriate application methods, and timing of application—are important for improved yield and quality of corn for silage production. The correct N requirement for silage corn production can be quantified by different rates of N fertilizer application under different irrigation systems.

Objectives
Objectives are to determine the effects of different irrigation levels and N rates on dry matter yield of corn for silage grown under on-surface drip irrigation (ODI) and sub-surface drip irrigation (SDI) systems.

Materials and Methods
The study was conducted in 2014 at the Powell Research and Extension Center (PREC). The study area is characterized by an arid climate with an average temperature of 62°F for the growing season and an average annual precipitation of 6.9 inches.

Two separate studies were conducted under SDI and ODI systems. The hybrid Pioneer ‘P8107HR’ was planted with row spacing of 22 inches. Each experiment consisted of three different irrigation treatments and five N rates in a randomized complete block design in a split-plot arrangement with four replications in the SDI and three replications in the ODI system. Irrigation treatments (main) included 100% (which is equivalent to 10 inches of water applied during the growing season), 80%, and 60% ETo (crop evapotranspiration, an indicator of the water needs of plants). Irrigation treatments were initiated after crop establishment. N rates were the sub-treatments and consisted of 0, 80, 160, 240, and 320 pounds per acre of a urea-ammonium-nitrate aqueous solution (UAN, 32% N) applied in two- to four-split applications at planting, V4, V8, and V10 stages of plant (the Vn stage is when the collar of the nth leaf is visible). Aboveground plant biomass was harvested at the R3–R4 (milk-dough) stage to determine dry matter yield. ODI and SDI data were analyzed using the statistical software R.

Results and Discussion
ODI and SDI curves indicate that the irrigation levels and N rates had an effect on corn dry matter yield (Figure 1). For both studies, the irrigation levels 100% and 80% ETo produced the highest yield while 60% ETo produced the

¹Department of Plant Sciences; *now at University of Minnesota.
lowest. No difference was observed between 100% and 80% ET0 treatments. As a consequence, 80% ET0 might be used for both irrigation systems for higher corn production.

Within irrigation systems, N affected corn silage yield. ODI curves showed a maximum yield response at 284, 190, and 187 pounds N per acre for 60%, 80%, and 100% ET0 irrigation treatments, respectively. These results suggest that such rates might be more effective for corn production under an ODI system. Regarding SDI, results showed an increasing trend of yield response to added N; however, maximum yield within the range of N rates used in this study was not achieved. This was probably due to the fact that water was applied at one foot deep, and perhaps N was leached.

The irrigation level 80% ET0 under SDI and ODI seems to have potential for beneficial corn silage production without compromising yield loss. Results also show an increasing yield response to added N. At least 187 pounds N per acre might be needed to make profitable corn for silage production under ODI and SDI systems.

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**Contact:** Abdelaziz Nilahyane at anilahya@uwyo.edu, or Anowar Islam at mislam@uwyo.edu or 307-766-4151.

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Figure 1. Dry matter yield response to different N rates and different irrigation levels under ODI and SDI systems. The means are presented for each N rate used in the study.