NITROGEN CYCLING IN A MANAGED SEMI-ARID AGRICULTURAL ECOSYSTEM

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Abstract

When greenhouse gas (GHG) emissions are discussed in the media and in everyday conversation, the main focus is on the three C's of GHGs: cars, coal, and cows. However, agriculture accounts for about 10% of the GHG production in the US, and is the major producer of nitrous oxide (N_2O). This is a natural product of microbial activity in the soil, but it may be stimulated by soil amendments. The potential sources of this flux have been studied across the United States, but have not been examined on the Texas High Plains in cotton (*Gossypium hirsutum* L.) production systems. In addition, there has been research into potential ways to mitigate this production through tillage regimes and altered nitrogen (N) fertilizer management. This study focused on the changes in GHG flux due to implementation of conservation tillage practices and altered N fertilizer application timings. This study was conducted in Lubbock, TX at the Texas A&M AgriLife Research station over two years (2016-2017). Cotton (DP 1321 B2RF) was planted in late May 2016, and early June 2017. The field design was a randomized complete block (RCBD) arranged as a split plot, with three replications. The main plot for this study was tillage: no-till with winter wheat cover (NTW), no-till winter fallow (NT), and conventional tillage (CT). The split plot was N fertilizer application timing: control (no added N), 100% pre-plant (PP), 100% side-dressed (SD), 40% pre-plant and 60% side-dressed (SPLIT), and 100% pre-plant with a N stabilizer (urease inhibitor) product from BASF (Limus). All N was applied as urea ammonium nitrate, 32-0-0 (UAN-32) at 168kg/ha via knife injection. Pre-season soil samples were collected for both years of this study. The results were similar from the two years, with an increase in residual nitrate-N for the 2017 season. It was noticed that the pH increased for the control plots in 2017 compared to the initial data taken in 2016, and the treatments with applied N were not affected. Residual nitrate-N was greater in the single application timing treatments coupled with the CT and NT treatments in 2017. In both years less residual nitrate-N was determined in the cover cropped treatments. Greenhouse gas measurements were taken in real time using a Gasmet DX4040 FTIR analyzer. Measurements were taken monthly and 1, 3, and 7 days post fertilizer application. Nitrous oxide was the main focus of this paper due to its production via denitrification and its potential role in N cycling in these systems. Cumulative values indicated an increase in N_2O losses in the NTW treatments for the single application timings compared to the rest of the combinations of treatments and tillage. This is potentially due to a more robust microbial community, which would naturally produce more of this product. All N timing treatments followed a similar pattern, with increases coming shortly after N application and little to no flux outside of the growing season. Negative fluxes of N_2O were determined in every treatment at some point during the two years of this study, and no positive flux was determined for control treatments over the two-years. This is hypothesized to be due to low soil-N levels that trigger some microbes to use atmospheric N_2O as an energy source under both aerobic and anaerobic conditions. Differences in cumulative fluxes were determined, however conservation practice did not significantly affect losses compared to the CT X PP treatment. There are other benefits to implementing conservation practices on the Texas' High Plains with reduced soil erosion being one of the most important. Recommendations cannot be made based solely off GHG mitigation potential at this time.