PhD project: Katrin Rychel

Fertilizer placement to increase nitrogen use efficiency and N2O mitigation

The objective of my research is to use a deeper placement of fertilizer as a strategy to both increase the N2/N2O ratio of evolved gasses and improve crop yield. Unlike the upper topsoil, soil at greater depth is less affected by precipitation events and higher temperatures that favor denitrification, thus a deeper fertilizer placement could minimize this process compared with a surface or shallow placement. If the fertilizer is placed deeper in the soil profile, there is greater opportunity for the full denitrification of NOx to N2 as the gasses diffuse to the surface. Additionally, there is evidence to suggest that N2O can be consumed in soils with low mineral N but otherwise favorable conditions for denitrification. With deeper N placement, less mineral N is present in the upper soil layer, potentially creating a zone that acts as a sink for N2O.

Deep fertilizer placement could also have a positive effect on crop N-use efficiency. With the fertilizer placed closer to the active root zone, it may be used more readily by the crops throughout the growing season and less is lost to runoff and nitrification and denitrification processes. Through field, lysimeter, and soil incubation experiments, I will test the effects of different depths of N fertilizer placement on the production of greenhouse gasses (N2O, CH4 and CO2) and nitrogen use efficiency. I will also investigate the microbial community structure, potential denitrification, and the quantity of N2O reducing gene copies at various depths in the different treatments.