

Agricultural use of nitrogen (N)-based fertilizer is a major expenditure for farmers and represents the largest anthropogenic source of nitrous oxide (N₂O) emissions to the atmosphere, accounting for 7% of US greenhouse gas (GHG) emissions. Efforts to minimize N loss to the atmosphere not only benefit farmers' bottom line, but can substantially reduce greenhouse gas releases from the production of field crops

Nitrous oxide is produced by soil microbes under both well-drained and low-oxygen, conditions. Under well-drained conditions, nitrifying bacteria convert ammonium to nitrate, producing some N₂O. Under low O₂, denitrifying microbes convert nitrate to dinitrogen, with N₂O released as an intermediate. Emissions of N₂O are difficult to predict because they represent the net effect of multiple, interacting, and highly variable processes influenced by a variety of environmental factors—soil pH, moisture, and temperature—but N fertilizer use is the key driver in agricultural systems. While other management choices influence N₂O emissions, including N fertilizer type, timing, and placement, the most important factor is the application rate. Nitrous oxide emissions have been shown to have an exponential relationship with increasing rates of N fertilizer application in maize crops in the Midwest US, allowing the calculation of GHG emission offsets associated with decreased N fertilizer application. However, similar studies are lacking for other crops in other regions, particularly in areas with different climate patterns, such as the Pacific Northwest.

In the southern Willamette Valley of Oregon, along with high N fertilizer applications, the rainy and mild climate, long growing season, and rich soils may promote significant N₂O emissions. This study measures the effect of different N fertilizer application rates on N₂O emissions in a major Pacific Northwest crop: grass grown for seed. Five rates of N fertilizer were applied to tall fescue (*Festuca arundinacea*) crops for two growing seasons in four fields with different management approaches. Emissions of carbon dioxide and N₂O were measured biweekly along with related environmental factors. We report preliminary results showing annual and seasonal N₂O emissions in contrasting management settings, as a function of N application rate and environmental variables. We present preliminary findings showing estimated GHG offsets from decreased N fertilizer application in tall fescue in Oregon.