Combining 4R Practices Avoids Pollution Swapping

Urea-based fertilizers (urea and UAN) are now the major source of crop nitrogen in North America, primarily because of economics. When urea-based fertilizers are added to soil they are unfortunately susceptible to ammonia volatilization losses to the air during urea hydrolysis. Appreciable loss of fertilizer N can reduce crop yields and degrade air quality.

New research published in the Journal of Environmental Quality examines the effects of N-placement and N-source on corn grain yield, ammonia and N₂O emissions. Broadcast urea without inhibitors lost 50% of the applied N (64.4 kg N/ha), whereas adding a urease and nitrification inhibitor with urea reduced ammonia losses by 64% and injecting UAN reduced losses by 60%. The combination of injection and the two inhibitors was the most effective, virtually eliminating ammonia losses and increasing yields by 19%.

An interesting twist to this study was the impact of urease inhibitors on N₂O emissions. When urease inhibitors decreased ammonia losses, more inorganic N remained in the soil which increased N₂O losses. Pollution swapping was avoided when both a urease and nitrification inhibitor were added. Hence adopting two 4R strategies reduced ammonia and N₂O emissions while enhancing crop productivity – a clear win for both corn production and the environment.


Assessing Impact of Fencing Livestock Out of High-Order Streams

Contamination varies with stream order as catchment characteristics influence inputs and in-stream processing. However, the relative influence and policy significance of these characteristics across a number of contaminants and at a national scale is unclear.

In the September-October issue of the Journal of Environmental Quality, researchers describe a model constructed to estimate the load of contaminants (nitrogen, phosphorus, sediment and E. coli) in New Zealand streams and rivers. The model was sensitive to stream order and size and was used to test if proposed government policy to fence-out livestock from streams less than 1-m wide, 30-cm deep and in catchment of a mean slope <15° would significantly decrease national contaminant loads.

On average, 77% of contaminant loads (varying widely by contaminant and region) came from streams that would not be affected by the policy. Fencing out small and shallow streams up to 28° would cost >$1.4B and be a significant drain on farm profitability. However, there are many good management practices that when targeted to critical source areas can be just as (or more) cost-effective than fencing. Targeting and implementing these practices is the best strategy to ensure that farms remain profitable while minimizing their effect on stream water quality.

Adapted from McDowell, R.W., N. Cox, and T.H. Snelder. 2017. Assessing the yield and load of contaminants with stream order: Would policy requiring livestock to be fenced out of high-order streams decrease catchment contaminant loads? J. Environ. Qual. 46:1038–1047. View the full open access article online at http://dx.doi.org/doi:10.2134/jeq2017.05.0212

Example of wind tunnels used to measure ammonia losses from a related study that included bare ground. Source: C. Drury.