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'N' inhibitors for N_2O emission reduction in garden land ecosystem

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Introduction

The impact of nitrous oxide (N_2O) released from the fertilized agro-ecosystems are of increasing concern. Nitrous oxide (N_2O) is a trace gas responsible for global warming and depletion of O3 in the stratosphere. Nitrous oxide (N_2O), is a potent greenhouse gas that is 300 times more effective at trapping heat in the atmosphere than carbon dioxide (CO_2) over a 100-year period. Agricultural practices, particularly the use of nitrogen fertilizers, are a major source of N_2O emissions. One approach to reducing N_2O emissions from agriculture is the use of nitrogen inhibitors. Utilizing nitrification inhibitors (NI) are effective methodologies to increase nitrogen retention and reduce N_2O emissions from soil. These are chemical compounds that slow down the conversion of ammonium (NH_4^+) in the soil to nitrate (NO_3^-) by microbes known as nitrifiers. Since nitrous oxide is an intermediate product in this process, slowing it down reduces N_2O formation.

There are several different types of nitrogen inhibitors, including:

- Nitrification inhibitors are compounds that reduce the rate at which ammonium is converted to nitrate either by killing or interfering with the metabolism of nitrifying bacteria. Dicyandiamide (DCD) is one of the most widely used bacterio-static nitrification inhibitors in the agriculture. Effect of DCD on N_2 O emissions has been reported by McTaggart *et al.* (1997) in ryegrass, grassland and spring barley.
- Nitrification Inhibitors (NIs) - These are applied directly to fertilizers or soil and can reduce N_2O emissions by up to 50%. Some common examples include nitrapyrin (trade name Nitrapyr).
- Urease inhibitors - These are applied to urea-based fertilizers to slow down the conversion of urea to ammonium, thereby reducing the amount of substrate available for nitrification. An example is N-(n-butyl) thiophosphoric triamide (NBPT). The use of nitrogen inhibitors can be a valuable tool for reducing N_2O emissions from agriculture.

Neem coated urea used as a nitrogen inhibitor

Neem-coated urea is a type of nitrogen inhibitor used in agriculture. It offers a distinct advantage over synthetic inhibitors due to its organic nature.

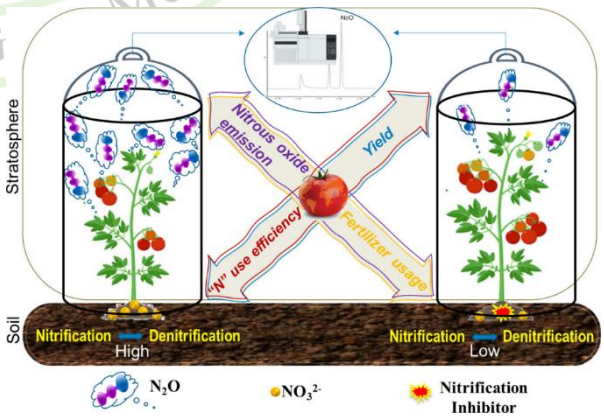
- Neem oil, extracted from the neem tree (Azadirachta indica), acts as the nitrification inhibitor in neem-coated urea.
- Research shows neem oil possesses properties that slow down the conversion of urea-derived ammonium to nitrate in the soil.

'N' inhibitor for N_2O emission reduction in rice ecosystem

Parameswari *et al.*, 2013 investigate the potential of Dicyandiamide (DCD), a nitrification inhibitor for minimizing N_2O emission from paddy soil representing Cauvery Delta. The greatest N_2O efflux was observed in all treatments on the second day after the fertilizer application. The average emission on the 0th day was 0.71 mg/m2/day, which increased to 1.83 mg/m2/day on the first day, peaked on the second day (2.78 mg/m2/day), and then dropped to 1.40 mg/m2/day on the third day. Thus, it was observed that there was a noticeable temporal variation pattern in N_2 O outflow associated with the substrate's depletion. Among the treatments, the Leaf Colour Chart (LCC) based N (@30 kg N/ha, with the LCC value 4 as standard) + DCD @ 10% of applied N was the lowest mean emission 0.46 mg/m^2/day, followed by the Site-Specific Nutrient Management (SSNM) based N with fixed split approach {35% N at 15 Days After Transplanting (DAT), 40% N at 30 DAT, 25% at 45 DAT} with the use of LCC at each stage + DCD @ 10% of applied N has lower N2O emission 0.61 mg/m^2/day. 5.14 mg/m^2 per day was the maximum emission during the treatment period, which included early N application completion (25 percent basal, 50 percent at 20 DAT, and 25 percent at 40 DAT). The flowering stage had the highest mean maximum N_2O emission of 2.12 mg/m^2/day among the phases, and the mean seasonal emission was calculated to be 0.16 kg ha^{-1}.

N_2O emission reduction in garden land ecosystem by using 'N' inhibitors

The effect of potassium thiosulfate (KTS) and neem-coated urea (NCU) on N_2O efflux under irrigated tomato cultivation was assessed by Davamani *et al.*, 2022. In this experiment they used STCR based NPK with normal urea and KTS at 1% of applied N (183:160:125 kg ha^{-1}), produced the least amount of N_2O emission and demonstrated good efficacy in inhibiting the nitrate reductase activity. In comparison to the general nutrient prescription (blanket recommendation of nutrients), STCR-NCU performed similarly to STCR-U + KTS, reporting a greater reduction of N_2O (21.1, 31.2, and 34.4% following the basal application, first and second top dressing, respectively) after fertilizer application. Additionally, the STCR-NCU (14.08%) and STCR-U + KTS (12.48%) tomato yields are higher with high-quality fruit that has low N_2O emissions and high levels of AA, Lycopene, and TSS.



Conclusion

Overall, neem-coated urea represents a promising strategy for improving nitrogen fertilizer use efficiency while reducing environmental impacts associated with conventional fertilizers. DCD reduces nitrogen losses from leaching (washing away) and volatilization (evaporation) by maintaining ammonium in the soil for extended periods. This allows plants to absorb nitrogen more effectively, improving overall NUE. By inhibiting nitrification, DCD helps mitigate N_2O emissions, contributing to a more sustainable agricultural approach. DCD is a well-established N inhibitor that offers significant benefits for improving nitrogen management in agriculture. However, it is crucial to consider its limitations and use it in conjunction with best practices for fertilizer application. So, the best N inhibitor choice depends on the specific situation, including fertilizer type, soil characteristics, and economic considerations. Consulting with agricultural experts can help determine the most suitable option for your needs.

References

McTaggart, I., Clayton, H., Parker, J., Swan, L. and Smith, K. (1997). Nitrous oxide emissions from grassland and spring barley, following N fertilizer application with and without nitrification inhibitors. Biol. Fert. Soils, 25: 261–268

Parameswari, E., V. Davamani, S. Arulmani, K. Saravanan, V. Ravi, and T. Jayaraj. "Assessment on the reduction of Green House Gas (GHG) emission by nitrification inhibitor under intensive rice system of Cauvery Delta Zone (CDZ)." *Assessment* (2013): 94.

Davamani, Veeraswamy, Ramesh Poornima, Subramanian Arulmani, Ettiyagounder Parameswari, Joseph Ezra John, and Mohan Deepasri. "Mitigation of nitrous oxide emission through fertigation and 'N'inhibitors–A sustainable climatic crop cultivation in tomato." *Science of The Total Environment* 813 (2022): 152419.