Role of Nitrification Inhibitors and Controlled Release Fertilizers for Efficient Nitrogen Management

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ABSTRACT

Nitrogen is one of the essential nutrients required for plant growth and development. Nitrogen management requires great attention because of low use efficiency of nitrogenous fertilizers. It is evident that to achieve food security, farming community is largely dependent on chemical fertilizers. However, overuse of chemical fertilizers causes nutrient loss from agricultural fields owing to many loss pathways. Nitrogen also undergoes many losses when applied to soil *viz.*, ammonia volatilization, denitrification, or nitrate leaching. To improve nitrogen use efficiency, it is essential to reduce its loss from soil. Use of nitrification inhibitors and controlled release fertilizers has been found useful to attain the goals of improved crop productivity and higher nutrient use efficiency.

INTRODUCTION

The global population is rapidly expanding and is expected to reach 9.7 billion by 2050. Such rapid growth is associated with rising demand for resources such as food, water, energy and space. Contemporary agriculture is already facing several challenges to keep up with this rising demand. Climate change, degradation of soil health, rapidly decreasing availability of arable land and the environmental impacts are some major challenges. It is universal fact that to achieve food security, farming community is

largely dependent on the chemical fertilizers. However, overuse of chemical fertilizers causes nutrient loss from agricultural fields owing to many loss pathways. Among all the essential nutrients, nitrogen (N) plays an important role in fulfilling the nutritional requirement of the crop and has been a major source of nutrition supplying protein to improve crop quality. Nitrogen management in agricultural fields requires great attention, especially in highly demanding crops. In addition to its role in crop growth and yield, N is easily lost from the soil to the environment, particularly as nitrate (NO^{3-})-N, causing the eutrophication of water bodies, or as greenhouse gases to the atmosphere (Coyne 2008; Mulla and Strock 2008). Owing to these losses, it becomes inaccessible to crops thereby, decreasing the N fertilizer use efficiency. Therefore, to improve the efficiency of nitrogenous fertilizers, it is essential to reduce N loss from soils. Several strategies can be adopted to improve N use efficiency and to reduce losses to the environment, namely the use of moderate rates and splitting N applications (Havlin et al. 2014). When N is applied through ammonium containing fertilizers and urea, the majority of it is lost through denitrification or leaching once it is converted to nitrate through nitrification. Thus, decreasing nitrification rate through management is desirable to decrease N losses and increase N fertilizer use efficiency. Furthermore, the use of some fertilizers with mechanisms to reduce the solubility or mobility of N in the soil can also have the potential to reduce N losses from agricultural soils. Nitrification inhibitors and controlled release fertilizers have such potential.

Nitrification inhibitors

Nitrification inhibitors are the compounds that delay nitrate production by depressing the activity of *Nitrosomonas* bacteria. These compounds temporarily reduce the population of *Nitrosomonas* bacteria in soil which convert ammonium to nitrite. By keeping N fertilizer in the ammonical state, NI reduce the N losses such as nitrification, denitrification, leaching and resulting in efficient utilization of N by plants. These are extensively used as an effective way to reduce N loss thereby, improving N use efficiency and boosting crop yields.

Nitrification inhibitors are of two types - Synthetic and natural/ biological. Synthetic NI includes Nitrapyrin, AM (2-amino-4-chloro-6-methylpyrimidine), Dicyandiamide, Thiourea, Acetylene, DMPP (3,4-dimethylpryazole phosphate), Terrazole/Dwell, MBT (2-mercaptobenzothiazole), etc. Certain plant species have ability to release organic molecules/compounds from their roots that specifically inhibit the function of nitrifying soil bacteria. For instance, Karanj (*Pongamia sp*.) cake, Neem (*Azadirachta sp.)* cake, *Mentha spicata*, *Brachiaria humidicola, Lolium perenne, Arachis hypogae, Moringa oleifera, etc.* These are termed as “biological nitrification inhibitors”.

Controlled release fertilizers

Controlled release fertilizers contain a plant nutrient in a form that delays its availability for plant and extends its availability to the plant significantly longer than "rapidly available fertilizers”. These fertilizers are designed to better match the timing of nutrient release to the plant demand. Because of the cost factors, their use in agricultural settings is limited although they are widely used in horticultural applications. Urea is one of the most widely used fertilizers in agriculture and is extremely soluble. Slow release coatings may be applied to limit solubility and delay urea hydrolysis and subsequent nitrification. Examples incude sulphur coated urea, neem coated urea, etc.

Another approaches for nitrogen management

- Integrated nutrient management
- Nutrient budgeting
- Use of leaf colour charts and chlorophyll meters

- Site specific nutrient management
- Use of remote sensing tools
- Crop simulation modeling

CONCLUSION

Losses of nitrogen from the soil and plant system not only reduces soil fertility and plant yield but also creates adverse impacts on the environment. Use of nitrification inhibitors is a powerful tool in reducing N losses and enhancing N use efficiency. Higher recovery of N is possible when the N is available to the plant for a longer period of time and this can be done by using controlled release fertilizers which release nutrients at a slow rate for longer period of time.

REFERENCES

Coyne, M.S. 2008. Biological denitrification. In: Nitrogen in Agricultural Systems. Agronomy Monograph n. 49 (eds. J. S. Schepers, W. R. Raun), Madison, Wisconsin, USA, pp: 201-253.

Havlin, J.L., Tisdale, S.L., Nelson, W.L. and Beaton, J.D. 2014. Soil Fertility and Fertilizers: an Introduction to Nutrient Management. Edn 8, Boston: Pearson, pp: 499.

Mulla, D.J. and Strock, J.S. 2008. Nitrogen transformation process in soils. In: Nitrogen in Agricultural Systems. Agronomy Monograph n. 49, (eds. J. S. Schepers, W. R. Raun), Madison, Wisconsin, USA, pp: 361-400.