Slow-Release Nitrogen Fertilizers

V. D. Mistry[1], P. S. Patel[2], H. R. Ramani[2], M. M. Patel[2] and A. P. Italiya[1]

[1]College of Agriculture, NAU, Navsari-396450

[2]Main Cotton Research Station, NAU, Surat-395007

Corresponding Author: hiteshramani2007@gmail.com

Introduction

The demand for plant nutrients will increase continuously with increase in population. About 70% of food grain production will be dependent on fertilizers. Fertilizers are applied in huge quantities especially nitrogenous fertilizers like urea to improve plant yield in order to meet demand. Nitrogen deficiency in plants could cause a decrease in productivity as nitrogen is a vital nourishment source for crop development. Nitrogen fertilizers account for approximately 56 % of global fertilizer consumption, followed by phosphate (24%) and potash (20%) fertilizers. In India consumption of N and P2O5 at 20.21 million MT and 7.92 million MT during 2022-23 registered increase of 4% and 1.2%, respectively, over 2021-22. However, consumption of K2O at 1.72 million MT witnessed a sharp decline of 32.2% during the period.

Nitrogen fertilizer is highly mobile and hygroscopic in nature when applied in soil. It can be lost through leaching, de nitrification and volatilization. Due to high solubility crops will only take up nitrogen in the range of 40-70% and this is not sufficient to meet crop requirements. Therefore, farmers have to apply an extra dose of this fertilizer and this costs money which affects farm economics. To solve this problem slow-release technique is the latest and highly developed method for feeding plants a source of nourishment.

Fertilizer type

Fertilizer is available in two types: **Liquid and Granular**

Liquid fertilizers are fast-acting. They are quickly absorbed, they require application every two to three weeks. Most are concentrates, mixed with water prior to application by a hose-end sprayer or a watering can.	Granular fertilizers is a solid fertilizer that comes in small, uniform granules. They are easier to control because one can actually how much fertilizer is using and where it's being dispersed. They are normally applied by hand or mechanical spreaders.

What is slow-release fertilizer?

- The basic concept of slow-release fertilizer is that they release their nutrient contents at more gradual rates that permit maximum uptake and utilization of the nutrient while minimizing losses due to leaching and volatilization.
- Slow-release fertilizers are the covered fertilizers whose rate of release is regulated by the outer coatings of different compounds.
- Slow-release fertilizers feed gently over a long period. Because the nutrients are surrounded by a special coating.
- Slow-release fertilizers need not be applied as frequently as other fertilizers and there is less potential of leaching into ground water.

Fast-Release Fertilizer V/S Slow-Release Fertilizer

Fast release fertilizer	Slow release fertilizer
Chemical or synthetic fertilizer	Natural, organic or synthetic long lasting fertilizer
Require frequent application	Less frequent application than FRF
Quick release period	Extended release period
No coating	Coated or uncoated
Leach quickly	Minimal leaching
Causes burning to plant	No plant burning happens

Why slow release fertilizer?

There are broadly two groups:

First group is formed by reacting urea with an aldehyde, which leads to the formation of a urea-aldehyde adduct with low solubility. Ex. Urea-formaldehyde (UF) 38% N, Isobutylidene diurea (IBDU) 32% N and Crotylidene diurea (CDU) 32.5% N

Second group includes coated conventional fertilizers. It includes various coating. Coating is a popular method for developing SRFs due to its simplicity, efficiency and most importantly, its ability to precisely control nutrient release rates through variations in coating thickness

Mainly and widely used fertilizers are,

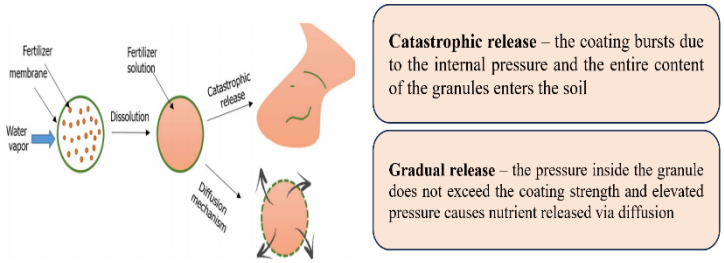
1. Sulphur coated urea 30-40% N
2. Neem coated urea 46% N
3. Polymer coated urea 40-44% N

Release mechanism of slow-release fertilizers

- Slow-release fertilizers employ different mechanisms to regulate nutrient release.

- Nutrient released should be based on a multi-stage diffusion model.
- After the application of fertilizer, moisture penetrates the granules through the coating pores.
- Pressure inside the granules increase gradually and the nutrients in the core are dissolved.

Two ways



Benefits of slow release fertilizer

- **Reduce nutrient losses:** Prevent leaching, volatilization and denitrification, protecting water quality.
- **Enhanced crop yield and quality:** Consistent nutrient supply promotes healthy plant growth.
- **Improved nutrient use efficiency:** Nutrients are released more gradually, matching the plant's need.
- Save time, cost and labour due to reduce in the fertilizer applications frequency from the conventional method.
- Availability of nutrient throughout the growing season

Conclusion

The response of crops to slow-release fertilizers are influence by factors like fertilizer dose, coating thickness and method of application. The application of different sources of slow-release N fertilizers *i.e.*, NCU, UF, SCU, BCU, ZnCU *etc.* significantly increased growth parameters and yield attributes in various tested crops like rice, wheat, cotton, maize, sorghum, peanut, rape seed and mustard, nutrient content and uptake with improving nitrogen use efficiency as well as soil available nutrients. Overall, the slow-release N fertilizer found effective for increasing the crop production and maintaining nutrient status in the soil through minimizing nitrogen losses from soil.

References

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