Stewardship SPECIFICS

No. 9

Managing Nitrogen to Meet Crop Demands while Protecting Water

Nitrogen (N) is often the first plant nutrient that limits the growth of crops such as corn, wheat, cotton, and rice. These and other crops usually require much more N than is supplied by the soil in order to achieve optimum crop yields and quality. It is necessary to make up that deficit by applying N fertilizer. Mineral fertilizers are often preferred over organic N sources for several reasons, including ease of application and management. Organic sources like manure should be appropriately used when available—full nutrient content known and credited, applied so that nutrient release matches crop demands, and risks of pathogen contamination are minimized.

Mineral fertilizers can be managed precisely, resulting in a N supply that can be targeted to meet crop demands. Any source of plant nutrients can have adverse impacts on water quality if good management practices are not followed. Here are a few of the techniques which farmers commonly use to control the loss of fertilizer N from the soil:

- **Apply N when the crop needs it.** Nitrate (NO_3^-), the form used in greatest amounts by plants, is highly water-soluble and can move freely through the soil with drainage water.
- **Application of N rates that match plant uptake requirements.** Applying only the amount of N required by the growing crop reduces the potential for N losses. Research has shown that when N is applied according to crop uptake demand, subsoil NO_3^--N levels are similar to those where no N is applied.
- **Split N applications into several doses, where proven agronomically effective, to give the crop adequate time to use it.** Dividing the crop's total N requirement into several smaller applications rather than one large application can be an effective way of increasing plant recovery of fertilizer N.
- **Application of ammonium (NH_4^+) forms of N.** This form of N is relatively stable in the soil and not prone to leaching loss like NO_3^-. Ammonium can be taken up by the crop or be converted by soil microbes to NO_3^-, often within a few weeks after application under warm and moist conditions.
- **Product technologies to keep N in the soil longer.** Several promising technologies can also be used to retain N fertilizer in the soil, including:
  - **Urease inhibitors** – when added to urea fertilizers, slow its conversion to ammonium, thereby reducing the risk of N loss as ammonia (NH_3) gas.
  - **Nitrification inhibitors** – when added to certain N fertilizers, slow their conversion to NO_3^-. By slowing this microbial process, N can be maintained in a form that is less susceptible to leaching loss and denitrification.
  - **Polymer or other coatings** – can provide a permeable shell that provides a controlled or slowed release of N into the root zone.
- **Use a balanced fertilizer program.** Nitrogen use efficiency and effectiveness can be increased when balanced with other essential nutrients such as phosphorus and potassium.

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It is impossible to grow enough food to meet ever-increasing world demands without N fertilization. One key to protecting water quality is to get as much of the fertilizer N into the plant, with very little remaining as NO_3^- in the soil following harvest. By employing best management practices and proven N technologies, crop yield goals and protected water quality can be achieved at the same time.

FOR FURTHER READING:

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