

RIGHT  
PLACE

## ENHANCE EFFICIENCY AND HELP PREVENT FERTILIZER LOSS

- Placing nutrients beneath the surface helps prevent loss
- Putting nutrients near the seed and in the plant root zone improves early uptake

## FERTILIZER INCORPORATION RAISES EFFICIENCY BAR

Placing nutrients where they are most beneficial to the plants they're intended to nourish can help prevent nutrients from escaping into the environment. Correct fertilizer incorporation is an example of how farmer and societal interest coincide — farmers invest in fertilizer to efficiently feed crops and accomplishing that goal helps prevent those same nutrients from negatively impacting surface and groundwater resources.

When nitrogen and phosphorus fertilizers are applied to the soil surface without incorporation into the soil, the potential for loss is often higher than if they are placed beneath the soil surface. Phosphorus, mixed with soil, has very low mobility. When left on the surface, however, it has the potential to raise the phosphorus concentration of runoff water that may leave the field. Relatively small amounts of phosphorus have the potential to adversely affect streams, rivers and other bodies of water. Regardless of source, excessive phosphate inputs to an aquatic system can cause algal blooms, sometimes leading to hypoxia, a depletion of oxygen in the water near the bottom of water bodies.



When soils are moist and warm, urea nitrogen can convert to ammonia gas and be lost, particularly if it is placed at or near the soil surface. Although getting nitrogen in the **right place** is an important component in protecting the nutrient, the **right time** is also critical. Nitrogen, typically supplied in the form of ammonium, converts to nitrate in the soil. Nitrate is very soluble and highly mobile so, if not taken up fairly soon by the plant, there is potential in certain types of soil for it to “leach” down into groundwater. And since groundwater can move laterally, there is potential for nitrate to reach surface water as well.

For farmers, losing nitrogen through either of these dynamic processes means a loss of financial investment as well as compromising the yield potential of their crop.

## BENEFITS OF GETTING NUTRIENTS IN THE RIGHT PLACE

In many cropping systems, farmers have the opportunity to enhance fertilizer efficiency and prevent fertilizer loss by placing nutrients beneath the surface. This can be accomplished with a broadcast application on the soil surface followed by tillage to incorporate the material. As more and more farmers adopt reduced tillage and no-till techniques, however, many choose to “band” their fertilizer — placing nutrients in a narrow, concentrated band near the seeds or seedlings. Typically, the fertilizer is placed just below the seed furrow or a couple of inches to the side.

Although these bands can also be applied to the soil surface, subsurface banding has the distinct advantage of placing the nutrients where they are readily available to the crop as well as reducing potential loss. Putting nutrients near the seed and in the plant root zone greatly improves the ability of roots to take up those nutrients early in the growing season. That’s especially important for phosphorus because it is extremely critical to early plant development in many crops.

And because phosphorus and potassium have low mobility in the soil, broadcast applications that are not incorporated can result in those nutrients stratifying and accumulating in the top 2 or 3 inches of soils. That stratification can result in lower plant uptake of phosphorus and potassium, particularly when topsoil is dry.

“What’s the right place for phosphorus? In the soil, not on the soil,” says Tom Bruulsema, Northeastern Region director of the International Plant Nutrition Institute. “Facilitating the availability of the sources and equipment to get P fertilizer into the right place is an important contribution toward better crops — and better water.”

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## **BETTER YIELDS, LESS N LOSS**

At Pellett Farms near Atlantic, Iowa, Bill Pellet uses a dual placement approach on corn acres, injecting a portion of his nitrogen, in the form of anhydrous ammonia, while applying a liquid NPK solution beneath the soil surface.

“It’s a lot faster and easier for us,” he explains. “It enables us to get our fertilizer on quickly and it places the fertilizer down in the soil where it’s available to the crop. That’s something that’s very beneficial — it’s more efficiently used. We think there is a particular advantage on the lower fertility soils. And even though the phosphorus is tied up in the soil, you can lose it if the ground washes. Placing it a little deeper helps prevent that.”

## **BEST MANAGEMENT PRACTICE PAY-OFF**

Subsurface banding of nitrogen and phosphorus is considered a best management practice (BMP) that protects surface water quality by dramatically decreasing nutrient runoff potential. It is also considered a BMP for protecting groundwater because crops can better utilize the provided nitrogen — if applied near the time of the plant’s need for the nutrient — leaving less in the soil to potentially leach into groundwater. An additional benefit from nitrogen incorporation is that it avoids the acidification near the soil surface that results from repeated broadcast applications. Acidification — lowering soil pH — can inhibit legume development and impact herbicide performance.

For phosphorus and potassium, nutrient efficiency is enhanced because the subsurface band lessens P and K fixation by limiting contact with the soil. In the concentrated zone there is enough phosphorus, for example, to overwhelm the clay, calcium and aluminum that could otherwise form stable compounds and reduce phosphorus availability to plants.

To combine right time and right place for nitrogen treatments, many farmers rely on a sidedress application after the crop is planted. Although sidedress applications can be surface treatments, many growers choose to place the fertilizer beneath the surface, usually mid-way between the rows of plants.

Pop-up, or starter, fertilizer applications are also used. Nitrogen and phosphorus, in small amounts, are placed in the same furrow with the seed at planting. This practice places the fertilizer in a zone where it is readily available to provide early nourishment for seedlings and it protects nutrients from erosion compared to surface placement. The amount of nutrient that can be applied in this manner, however, is small — considerably less than the amount the crop will remove with harvest.

## AN OPPORTUNITY FOR BETTER STEWARDSHIP

Specific recommendations regarding fertilizer placement vary with the target crop but the basic principles remain the same — incorporating nutrients can substantially reduce the risk of nutrient loss and benefit crops by enhancing fertilizer availability.

A growing awareness of potential environmental impact as well as the opportunity to increase nutrient efficiency makes fertilizer incorporation a practice to be considered for an increasing range of crop and soil situations. Growers who want to become better nutrient stewards— and participate in the 4R nutrient stewardship initiative — need to continually adapt practices to apply the **right nutrient source**, at the **right rate**, **right time** and **right place** for their site-specific conditions.

## RESOURCES

- [Northeast Region Certified Crop Advisor Study Resources - !\[\]\(79de0df6c6ddd2d4eb74f1cc5f48ec50\_img.jpg\) Fertilizer Placement Methods](#)
- [University of Minnesota Extension - !\[\]\(d4c9768318b38eff1042b07478e20b4c\_img.jpg\) Use of Banded Fertilizer on Corn Production](#)
- [International Plant Nutrition Insitute !\[\]\(27d314856359a9d7feca17161bc1f4a4\_img.jpg\)](#)

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## THE 4R MISSION

Fertilizer is a component of sustainable crop production systems, and the fertilizer industry recognizes the need to efficiently utilize these nutrients. This site provides science-based information for stakeholders to utilize for education, advocacy, and implementation of crop nutrient stewardship. It provides information on fertilizer best management practices that benefit the environment and the producer's bottom line. The site is a collaborative effort of the fertilizer industry.

The guidelines for the 4R principles are endorsed and supported by the International Plant Nutrition Institute, The Fertilizer Institute, The Canadian Fertilizer Institute, and the International Fertilizer Industry Association.