

Get the Edge on Fertilization Management

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Fall Nitrogen Application—Factors to Consider



Dr. Adrian M. Johnston,

Northern Great Plains Region Director, PPI/PPIC

FALL APPLICATION of fertilizer nitrogen (N) continues to be a common practice in large areas of the northern Great Plains. Fall application provides the opportunity to apply the majority of the crop N requirements in advance of seeding at a time when cooling soil temperatures slow down the conversion of ammonium (NH_4^+)-N, such as from anhydrous ammonia (NH_3) and urea, to a nitrate (NO_3^-) form. Fall application of fertilizer N often provides the opportunity to capture some price advantage, also.

Have you ever wondered what happens to fall-applied fertilizer N in the field after application? If not, it's time to consider the transformation of this N treatment.

Several factors influence fall-applied fertilizers:

- **Form of fertilizer.** The form of N applied has a big impact on the role that application timing has on potential losses. Any NO_3^- -N is more subject to losses, and as a result the preference is to use NH_4^+ -forming N fertilizers like urea and anhydrous NH_3 .
- **Placement of the fertilizer product.** Broadcasting, banding, or nesting the fertilizer influences the rate of conversion from NH_4^+ form to NO_3^- form. Banding fertilizer slows conversion to NO_3^- . The banding process with NH_4^+ -forming fertilizer slows microbial activity by maintaining high soil pH, high concentrations of NH_3^+ , and increased osmotic pressure within the fertilizer band. Together these factors lower the risk of N immobilization, slow nitrification and reduce N losses by leaching and denitrification.
- **Soil moisture content appears to be the principle driving variable, with low soil moisture in the fall and early spring reducing the potential for loss of fall applied N.**

For many farmers, fall N application plays a major role in helping to reduce the spring workload... it requires fewer spring tillage operations, and capitalizes on potentially lower fall fertilizer prices. Where fall rains are common to an area, we generally see earlier fall application rather than later. Unfortunately, early fall application of

NH_4^+ -N fertilizers are likely to form more NO_3^- prior to soil freezing, increasing the potential for spring losses of NO_3^- -N by leaching and denitrification. That's why Extension agencies and crop advisers often recommend that fall-applied N be the NH_4^+ form, be banded rather than broadcast, and that application be made after the soil temperature has dropped below 40°F (5 °C).

Proper timing of fertilizer application can greatly improve the efficiency of fall-applied N and can have implications for farm profitability and environmental sustainability. The values provided in **Table 1** illustrate the range of crop responses that can be expected based on fall moisture conditions. As fall soil moisture increases, the potential benefit of a fall-applied treatment decreases.

Table 1. Relative crop yield response to time and method of N application in the northern Great Plains region.

Fertilizer timing and placement	Relative efficiency (based on spring broadcast and incorporated at 100%)		
	Manitoba	Saskatchewan	Alberta
Fall broadcast and incorporated	80%	75-90%	65-95%
Fall banded	100%	110-135%	85-120%
Spring broadcast and incorporated	100%	100%	100%
Spring banded	120%	115-130%	105-120%

The relative performance of a fall N application has a lot to do with the moisture and temperature conditions at application time, and shortly thereafter. The low-lying areas of a field are more prone to water accumulation and subsequent losses of NO_3^- -N. This is illustrated in the data shown in **Table 2**, where the performance of fall and spring applied urea data were compared for grain yield, total N uptake, and fertilizer N use efficiency (NUE). Application in low-lying areas was best in the late fall or early spring, while no difference was recorded in the high landscape positions. Delayed application date also means a lower soil temperature, another factor impacting N losses. It is interesting to note that in this study these two landscape positions were in the same field and separated by as little as 100 ft.

The results presented in this summary of fertilizer N timing indicate a wide range of

Table 2. Response of wheat to N fertilizer timing in high and low landscape positions, average of four trial locations in Manitoba (N applied at 71 lb N/A).

Landscape position	Fertilization timing	Grain yield, bu/A	Total N uptake, lb/A	Fertilizer NUE
High	Early fall	37.9	103.5	44
	Mid fall	38.0	104.1	44
	Late fall	37.2	103.6	44
	Spring	36.7	105.0	46
	Control	28.8	72.5	-
	Early fall + inhibitors	36.7	100.1	39
	<i>Fall NO₃-N to 12 in. (to 48 in.)</i>		<i>36 lb N/A (123 lb N/A)</i>	
Low	Early fall	29.1	74.0	39
	Mid fall	28.7	74.8	40
	Late fall	32.4	84.7	54
	Spring	32.5	85.6	55
	Control	18.5	46.5	-
	Early fall + inhibitors	29.4	76.9	43
	<i>Fall NO₃-N to 12 in. (to 48 in.)</i>		<i>27 lb N/A (71 lb N/A)</i>	



Nitrogen fertilizer form, placement, and soil moisture are important considerations.

possible responses. In summary we can conclude the following.

- **Crop response in the high landscape position showed no difference between time of N application, reflecting a lower amount of N loss.** In addition, the high landscape positions were always higher yielding than the low landscape positions.
- **The time when N was applied resulted in significant differences in the low landscape position, with early and mid fall providing lower yield responses than the higher yielding late fall or spring application timing.**

- **The lower N uptake and crop yield reported in the low landscape positions indicates greater N losses.** The same results are reflected in the range of loss reported by provincial and state authorities for N response timings in **Table 1**.
- **On a relative basis the NUE of the best treatments in the low landscape position were highest, but the total N recovery from these treatments was much lower than that recorded for the high landscape position.**

Fall N application, while a widely used practice, does come with some potential for N losses from the soil system. Understanding how fields fit into the upper versus lower landscape systems, and the impact that fall moisture can have on N losses, are both critical to rating the crop response to fall-applied N. **While it is a very effective means of applying N in vast areas of the northern Great Plains, fall N application has limits which must be observed to optimize crop response.** ■

For more information, contact:

Dr. Adrian M. Johnston

Northern Great Plains Region Director

Potash & Phosphate Institute (PPI)

Potash & Phosphate Institute of Canada (PPIC)

12-425 Pinehouse Drive

Saskatoon, Saskatchewan, Canada S7K 5K2

Phone: (306) 956-0619

Fax: (306) 956-0605

E-mail: ajohnston@ppi-ppic.org