



How to Get Better First-Year Nutrient Recovery Out of Fall Dry Fertilizer Applications



As summer fades, many growers around the country are starting to think about how to best implement and manage their fall dry fertilizer programs. Before the spreaders take to the field, growers will need to answer a number of important questions, such as:

- Is the weather going to allow the application?
- How much fertilizer does the next crop need based on soil tests and removal rates?
- What type of fertilizer do I choose?
- What is the price of fertilizer now versus the likely price next spring?
- Am I trying to maintain or build nutrient levels in the soil?

The majority of growers who apply dry phosphorus (P) and potassium (K) fertilizers in the fall will also have two other major concerns:

- What amount of applied fertilizer will become or remain available to the crop in the following growing season?
- How can I get better first-year recovery out of my dry fall fertilizer application?

One way for growers to answer these questions and make management decisions is by understanding the efficiency of P and K fertilizers. In this white paper, we will talk more about P and K fertilizer efficiency and about some ways to help growers get better first-year nutrient recovery.

But before we go too deep, let's review a little history first.

The Rise of Hybrid Corn: Changing the Way Farmers Fertilize

More than two generations ago, US farmers applied manures—both animal wastes from the barnyard (e.g., from chicken, hogs, and cattle) and green manures such as vetch and clover—instead of the sources and forms of P and K that are popular today. Nutrient demands from open pollinated corn varieties were met by these organic nutrient sources. However, crop yields were just a fraction of what they are today.

The Great Depression and Dust Bowl years exacted a great price from farmers and livestock, but were also the impetus for a tremendous advancement in corn production: the widespread demand by farmers for hybrid corn. Developed by Donald F. Jones in 1917–1918, double-cross hybrid seed corn technology was tested and proven in the teeth of the Dust Bowl. By 1960, 96.3% of corn acreage was planted with hybrid varieties.¹

This dramatic increase in corn yield potential and production also led to a change in how farmers fertilized their corn. Barnyard wastes and green manures were no longer enough to satisfy nutrient demands from hybrid corn.

Although some areas of the country still rely heavily on manures and litters for nutrients and as a way to dispose of waste products from animal operations, inorganic or commercial fertilizers have now become the standard practice over many organic sources.

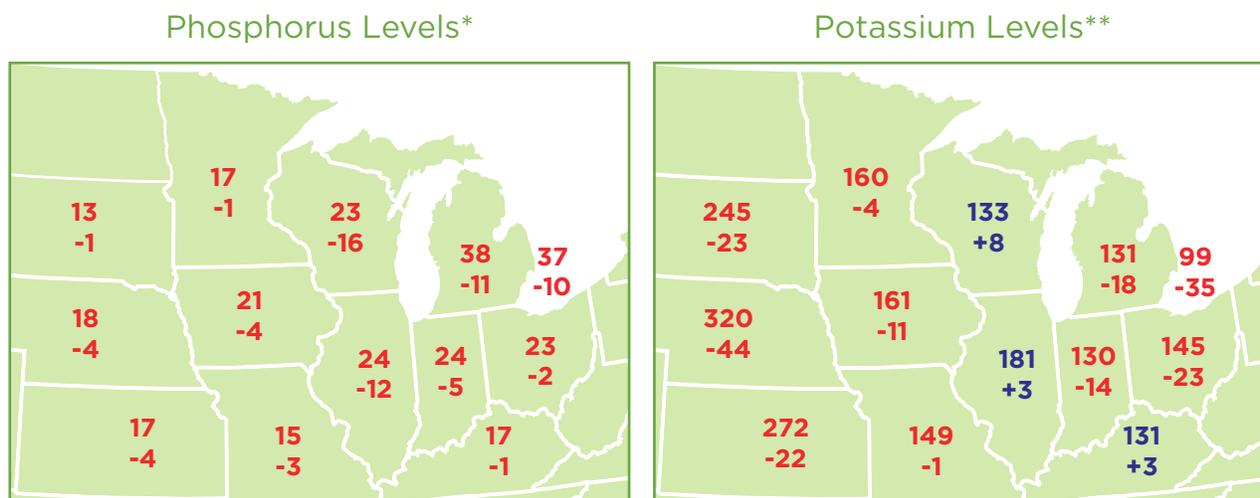
Satisfying the Nutrient Demands of Hybrid Corn: Are We Doing Enough?

Even though the use of commercial inorganic fertilizers has risen dramatically in the past 50 years, recent soil test information from the International Plant Nutrition Institute (IPNI) suggests that growers are not keeping up with P and K demands of new high-yielding corn varieties.

Today, a 200-bushel corn crop requires 256 units of nitrogen (N), 103 units of P, and 263 units of K (these units take into account NPK in corn residue).² But as grain production increases, the demand for NPK also increases. In spring and summer seasons with ample moisture, corn yields can surpass the 200 bushel/acre mark by as much as 20-50 bushels/acre, leading to a drawdown of soil P and K levels because the fertilizer application was calculated and applied for the 200 bushel/acre yield.

To illustrate this phenomenon, Figure 1 below shows the changes in P and K levels in the Corn Belt from 2005-2010.³ All of the Corn Belt states experienced a reduction in soil P levels from 2005 compared to 2010, and most states declined in soil K levels as well.

2010 Median Soil Levels and Change From 2005



*Median Bray P1 equivalent, ppm; Soil samples, millions: 2005=2.0; 2010=3.0

**Median ammonium acetate K equivalent, ppm; Soil samples, millions: 2005=2.0; 2010=2.8

Figure 1. Median soil P and K levels (50 percent of samples are above and below these levels) for the Corn Belt states and Ontario. The lower numbers in the maps are the changes from 2005. (Source: IPNI Corn Belt Fertility Study: 2010)

Another alarming issue is the inefficiency of our applied P and K fertilizers. Figure 2 below reveals the stark inefficiency of applied P fertilizers and the wide range of efficiencies for applied K fertilizers.

Primary Nutrient	First Year Efficiency/Recovery
Nitrogen	~50%
Phosphorus	10-30%
Potassium	20-60%

Figure 2. First-year nutrient efficiency/recovery. (Source: IPNI & Western Fertilizer Handbook)

The Answer May Be in the Soil Chemistry and Biochemistry

To help answer that question, there are a few important points to remember about interactions that occur in the soil-plant system when dry fertilizers are applied:

- Essential crop nutrients are taken up into plant roots as positively charged cations or negatively charged anions (e.g., Ca^{+2} , NO_3^-).
- The soil itself has a net negative charge and attracts or holds positively charged cations on cation exchange sites (cation exchange capacity, CEC).
- Negatively charged anions like nitrate have a high propensity to move below the plant root zone if excessive soil moisture is present.
- Chemical reactions (soil chemistry) also play an important role in the formation of compounds that are vital to plant growth. The mineralization of organic N and P is one example of this type of reaction.
- Strong attractions among cations, anions, and other compounds can prevent plants from accessing essential nutrients (e.g., when Ca^{+2} & Fe^{+2} bind to PO_4^-).

When faced with these interactions, we must rely on the biochemical compounds produced by microorganisms to react with and release the bound nutrients, making them available for plant uptake and utilization.

TITAN XC, a fertilizer biocatalyst, can be incorporated into a grower’s existing dry fertilizer program to increase P and K availability and improve plant uptake. The concentrated biochemistry in TITAN XC speeds the breakdown of dry fertilizers for rapid and efficient nutrient release (Figure 3). This means that more of the applied fertilizer will become or remain available to the crop in the growing season, helping growers answer a crucial management question.

How It Works: **TITAN[®]**
XC

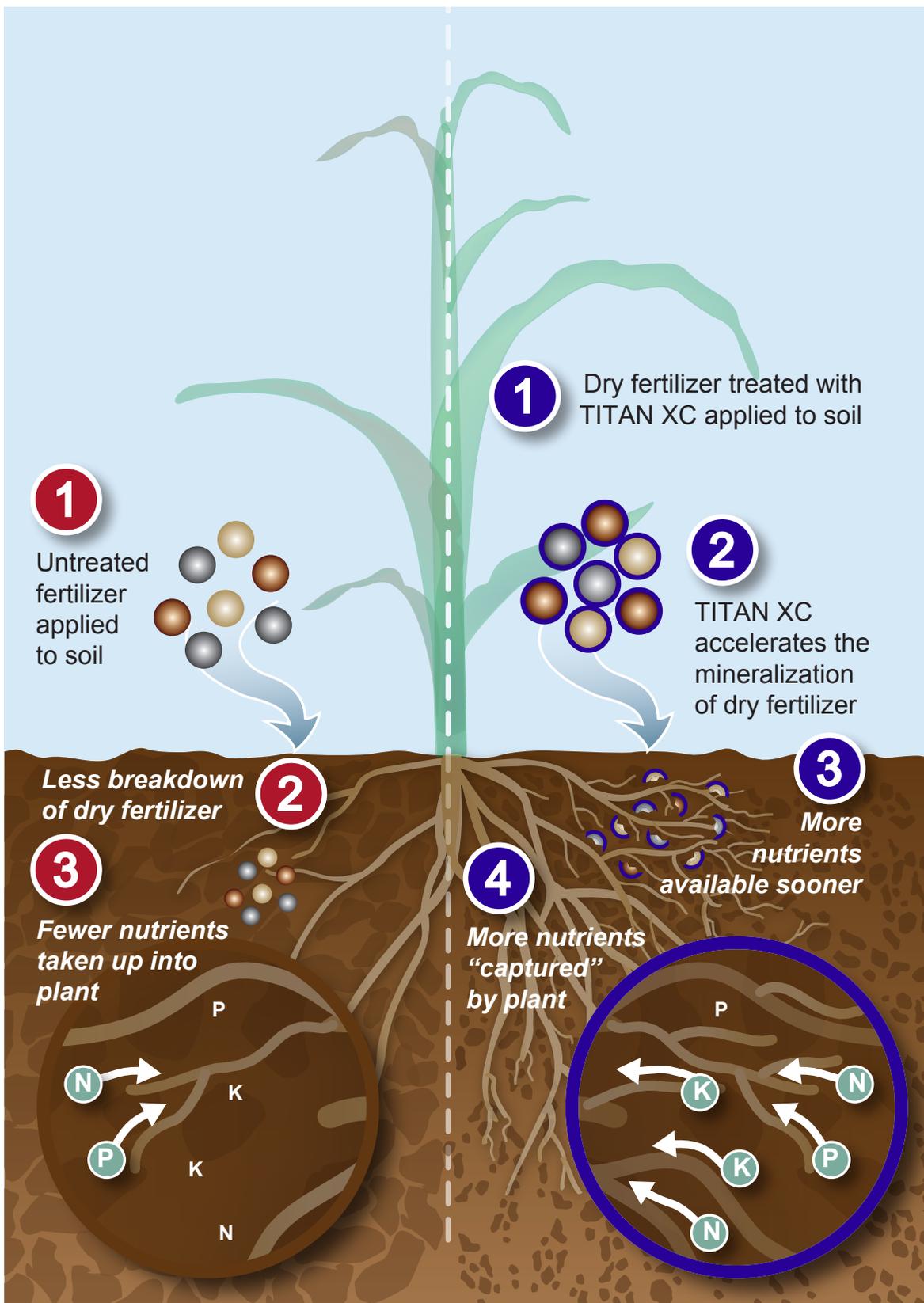
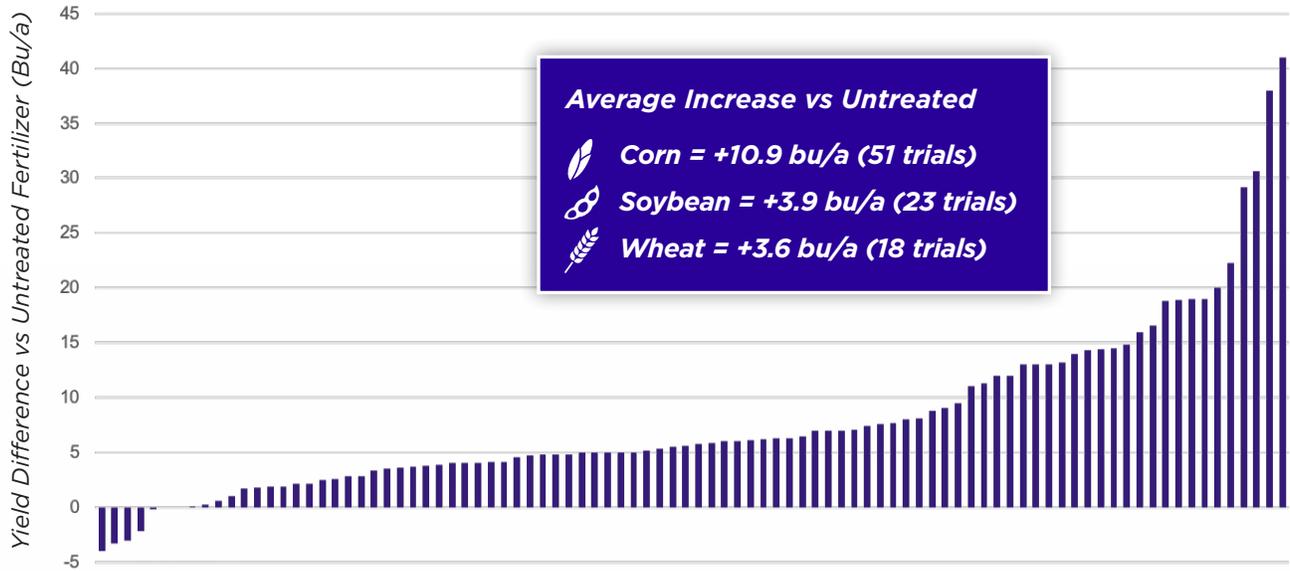


Figure 3. TITAN XC both accelerates and increases the breakdown of treated dry fertilizers. This makes nutrients more available for plant uptake and utilization, leading to increased root growth and yield.

2010–2019 TITAN Meta-analysis

92 Third-Party Trials and Side x Side Trials

Yield in Bushels/Acre Over Untreated Fertilizer



Conclusions

With some simple planning, it's easy to get more nutrient recovery from any fall dry fertilizer application. The end result is increased crop yields and total economic return from your growing program.



References

1. Sutch R. (2011). The Impact of 1936 Corn Belt Drought on American Farmers' Adoption of Hybrid Corn. In: Libecap GD and Steckel RH, eds. The Economics of Climate Change: Adaptations Past and Present (p. 195 - 223) Chicago, Illinois: University of Chicago Press.
2. Mosaic Company's Nutrient Removal App.
3. IPNI Corn Belt Fertility Study: 2010. Available at: <http://www.croplnutrition.com/ipni-corn-belt-fertility-study-201>.

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