# The Science Behind NutrientStar

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## ABSTRACT

NutrientStar is a science-based assessment and education program that is focused on products and tools that are marketed to increase nitrogen use efficiency. The program was initiated about three years ago by the Environmental Defense Fund with a primary focus on corn production in the Mississippi River Basin. NutrientStar operates with support from a panel of ten soil scientists plus administrative consultant staff. Panel activities include developing recommended protocols for plot and field studies to document the efficacy of products and N management tools. Information available on the website includes a listing of published studies and findings for various products. Results from Adapt-N field trials from 2011-14 have been summarized and illustrate the influence that soil properties and weather conditions have on corn yield, nitrogen use efficiency and partial profitability. Data generated from replicated N-rate strip trials in 2016 are being used to test the Adapt-N and FieldView algorithms. NutrientStar also works with the ag industry to develop dialogue and consensus around research protocols for testing N efficiency products and tools. A unique aspect of NutrientStar has been the use of Technology Extrapolation Domains (TEDs) to characterize locations for their potential for N losses via nitrate leaching or denitrification. TED classes should help explain performance of N management products and tools. The TED classification data-base is automated for on-line use and includes growing degree days, temperature seasonality, the annual aridity index and soil water holding capacity. NutrientStar program information - including the TEDs classification tool - can be found at www.nutrientstar.org.

## INTRODUCTION

Farmers across the Corn Belt want to manage fertilizer for greater productivity and profit, and to be recognized for their stewardship rather than continuously blamed for the water quality problems in major lakes and rivers linked to fertilizer losses. The agriculture marketplace is flooded with tools and products claiming to help farmers manage fertilizer. Such tools include optical sensors and decision support software and technologies, and products like nitrogen stabilizers. But how do farmers know which tool or product will help them manage fertilizer, and what are the benefits? The tools and products perform differently based on regional climate and soils, management scenarios, crops, annual precipitation and equipment. However, many companies market their tools and products as applicable to most commodity crops, despite the absence of publicly available data showing broad applicability of the tools and products. Farmers and their advisors have little other than marketing information to help them choose which tool or product is right for their operation, and under what circumstances, and it is expensive for farmers to measure

how much they might be improving fertilizer management by using a tool or product.

Enter NutrientStar – a program to scientifically assess fertilizer management tools and products and report those findings to the public. NutrientStar increases transparency and access to data on performance of commercially available fertilizer management tools and products; provides a common set of standards and protocols for measuring performance; and aims to spark further innovation, research and development of fertilizer efficiency tools and products.

NutrientStar offers broad benefits to many agriculture stakeholders. By establishing common field trial protocols for on-farm research within an agro-ecoregional framework, companies can test tools and products broadly and inexpensively, yet in a scientifically robust way. By providing information about how tools and products perform according to environmental and management conditions, farmers and advisors can make better farm-appropriate decisions. The situation is that above normal precipitation is the predominant drive for N losses via nitrate leaching and denitrification. The extent to which producers try to anticipate these losses is unknown, but can be significant. A recently developed tool used within NutrientStar is the Technology Extrapolation Domain (TED) software that characterizes fields according to their ability to support crop growth and store water. The TEDs inherently identify location and soil combinations that facilitate nitrate leaching in one extreme to denitrification in other cases.

Quantifying fertilizer efficiency gains and calculating partial profitability for field trials can reveal challenges to producers because it becomes a balancing act between fertilizer input costs and yield. Reducing N rate will intuitively increase NUE, but if profitability decreases producers will be reluctant to accept these recommendations without other incentives.

The major uncertainty when comparing practices that are associated with an N management tool or product is the quality of the producer practices that are used as a reference. Successes in the mind of producers are when the tool or product increases profitability. Increasing NUE is a bonus. Tools and products that reduce partial profitability or NUE should be a concern. Further investigation in terms of weather deviations from normal and yields that are below the county average can help explain the likelihood of N loses. In 2016, a series of replicated N-rate strip trials was initiated to calculate the economic optimum N rate (EONR). These trials will be used to compare the N fertilizer rate recommended by the tools with EONR.

**Tools and products assessed** *(previously or ongoing)*

The following products and decision support tools are among the first set of tools to be assessed by NutrientStar. Others will follow.

| Products | Decision Support Tools/hardware |
|---|---|
| Instinct II (Dow AgroSciences) | Adapt-N (Agronomic Technology Corp.) |
| N Serve (Dow AgroSciences) | Farmer's Edge (Farmer's Edge Laboratories) |
| ESN (Agrium) | FieldView Pro Nitrogen Advisor (Climate Corporation) |
| Agrotain, Agrotain Plus & SUPER U (Koch Agronomic Services) | Y-Drop & SoilScan (360 Yield Center) |
| Limus (BASF) | NextField (Cargill) |
| Nutrisphere N (Verdesian) | OptRx (Ag Leader Technology) |
| Ammonium Thiosulfate | |
| DCD | |
| Slow Release Foliar N products made from methylene urea | |

Website information pertaining to the tools and products should be of value to producers, agrichemical suppliers, and food supply chain companies – as well as retail consumers – so they can better understand how the grain they buy is grown more sustainably.

Visit http://nutrientstar.org/ for more information.