Calibration and validation of NutriSphere-N Nitrogen Fertilizer Manager

Brief Introduction

Global agricultural use of synthetic nitrogen (N) has increased substantially over the last 50 years at a CAGR of 2.5% contributing to both increasing global food supply and N loading in the environment. Today, it is estimated that 29 million metric tons of N fertilizers are stabilized in the U.S. representing a market of approximately $204M. Preserving N fertilizers applied in plant available forms has proven effective in increasing N use efficiency and reducing N losses to the environment. In 2007, NutriSphere-N Nitrogen Fertilizer Manager (N-N), a maleic-itaconic copolymer, was commercialized globally to assist growers in increasing the efficiency of liquid and granular N fertilizers applied to various crops and cropping systems. To date, N-N has been used on >34M acres worldwide applied as liquid (NutriSphere-N) or dry (NutriSphere-N QDO) treated fertilizer. Overall, more than 475 in-house and third-party replicated research and demonstration trials were conducted on >20 crops grown on six (6) continents (except Antarctica) and in 40 US States. Field trials have proven N-N increases average yields by 8.7% across all crops evaluated and with a grower return-on-investment ranging from $24.00 to $50.00 per acre.

Quantifying Yield Responses and Financial Advantages

Traditionally, replicated field trials were arranged in randomized complete blocks designed to determine the net effects of N-N on inhibiting various forms of N loss but also contributing to a net yield response on numerous crops. Yield comparisons were often made among a range of fertilizer treatments (low to high) either treated with N-N or not and an unfertilized control. Reduced rates of N fertilizer were employed to indirectly demonstrate the effectiveness of N-N on maintaining adequate amounts of soil-applied N versus rates identified as 100% of the grower-applied N rates. Verdesian has studied its N-N brand of products on crops grown under irrigation and on dryland acres; no till, strip till, and traditional tillage systems; high organic matter and low organic matter soils; fertigated, broadcast and incorporated nitrogen, and under mainstream farming practices.

Simply structured side-by-side comparisons of untreated (or grower’s standard fertility practice) versus N-N treated fertilizers were also used to demonstrate the effectiveness of N-N on enhancing the performance of crops via increased yields. Financial return-on-investment calculations were based on April 2015 commodity prices quoted by the CBOT (see Fertilizer Efficacy and ROI section).
Aggregated Research Results (2000-2014)

*Yield and Fertilizer Nitrogen Fertilizer Efficiency and ROI*

The aggregate yield data represent the average yield response for all NutriSphere-N trials conducted between the years 2004-2014, wherein average yields were increased 13.2 bu/acre for corn and 7.3 bu/acre for wheat (Chart 1). Data has been partitioned in order to illustrate similar positive response to N-N treatment between crops. On average, N-N applied to corn, wheat, and cotton increased crop yields by 7.5%, 10.1%, and 9.9%, respectively. For all crops combined, average yield increased by 8.7% with N-N application (see Charts 1, 2, 3, 4, and 5). Based on the data, expected ROI for N-N use on corn is approximately $40/acre based on $13/acre materials cost. ROI for wheat and cotton are approximately $24/acre and $50/acre respectively (corn = $4.00/bu; wheat = $5.00/bu; cotton = $0.60/lb lint; N-N cost by crop: corn = $13/acre; wheat = $11/acre; cotton = $6/acre).

A study from the University of Maryland shows the effects of N-N use on nutrient efficiency by means of positive yield response. Average corn yields from 130 gal banded UAN without N-N are comparable to yields using only 90 gal banded UAN with N-N (0.5% w/w). This suggests a 30% increase in N efficiency when using N-N with UAN on corn (see Chart 6; Mulford 2005). The financial ROI from the addition of N-N was calculated at $50/acre based on $1.90/gal UAN and $26/acre cost for N-N.

Trial data from third-party independent research shows a similar response with lower (40 to 60 gal) UAN rates. Again, by adding N-N, yield results are held constant even with decreased N rates. By lowering the UAN rate by 20 gallons per acre, the grower fertilizer input cost decreased by 33% alone (see Chart 7).

Similarly, a number of independent research studies have also provided similar results to the third-party replicated trials shown here. Gordon (2014) reported an 8.1% increase in grain corn production when using N-N coated urea versus untreated urea, and a 20.8% increase in yield over untreated check. Heiniger et al (2014) illustrated a 3.3% yield increase for UAN treated with N-N (e.g., 0.5% w/w) versus UAN untreated applied at planting and a 6.0% increase with N-N applied at layby. Wiatrak et al. (2014) measured a 15% increase in corn yields with fall-applied N-N treated urea over untreated urea, and 16.3% increase following N applied in spring with N-N compared to the untreated. In a separate study, Wiatrak (2014) observed corn grain yield increases of 33.3% and 29.5% with N-N applied at planting with 80 lb and 122 lb N/acre, respectively. N-N also improved corn yields by an average of 19.6% over untreated N in split applications.
Use of the Product

1. The rate of NutriSphere-N is fixed at 0.25% (w/w) for NutriSphere-N for granular nitrogen (2 quarts per ton) or 0.50% (v/v) for NutriSphere-N for liquid nitrogen fertilizers (2 quarts per 100 gallons). Nitrogen stability in the field from UAN or urea applications, broadcast or incorporated, provide many challenges to growers all over the world as the efficiency can be as low as 50% uptake and utilization of applied N.

2. Education of the service provider as a distributor, dealer, or Verdesian Life Sciences tech member is the key component in the success and proper utility in using NutriSphere-N. Training helps farmers understand how nitrogen loss happens, and which practices can grow yields and enhance efficiencies in his or her operation. All of the components of the chain of custody before deployment and customer commitment are important. Each person is required to pass on knowledge about the problem of nitrogen loss and how NutriSphere-N can help. This requires test plots and ‘show-me’ side-by-sides at a local dealer-by-dealer and location-by-location level which support the overall dataset, showing the yield and efficiency advantage provided by NutriSphere-N. At the end of the day, the message is increasing nutrient efficiency and profitability for progressive growers, and must be communicated again and again to ensure everyone does the right thing for his or her respective operation, environment, and business.

3. Over-application of nitrogen and growing conditions conducive to nitrogen loss hinder product performance. Normal farming practices under-apply nitrogen and are restricted to inefficient broadcast surface applications making over-application of nitrogen an anomaly in most years. Communication of the efficiency factors realized with NutriSphere-N, and generally recognized good practices such as split-application show the benefits and proof that NutriSphere-N is not a silver bullet but a tool in the toolbox. Additionally, utilizing the 4R approach advocated by The Fertilizer Institute allows customers to see the big picture about why efficiency is so important and how they can profit at the same time.

4. NutriSphere-N has a volumetric rate and thus the price per acre is dependent upon the amount of fertilizer being applied. Approximate grower costs per 100 pounds of urea (46 units of N) are $3.82. With UAN approximate grower cost is $0.31 per gallon of UAN applied i.e. if the grower applied 25 gallons of 32% UAN (113 units of N) the NutriSphere-N would cost $7.75 per acre.

According to Verdesian’s historical dataset on corn fertilized with NutriSphere-N treated urea and UAN the average yield response is 13.2 bushels per acre better than untreated. If a grower was applying 25 gallons 32% UAN per acre (113 units of N) the grower cost would be $7.75 per acre and the net ROI is $45.05 per acre at $4/Bu. corn. With urea, if a grower was applying 326 pounds per acre (150 units of N) the grower cost would be $12.45 per acre which would net the grower an ROI of $40.35 per acre at $4/Bu. corn.

5. Product data is collected through third-party contract researchers primarily, followed by side-by-side on farm research at a local level. This stair-step approach provides intimate, accurate data and feedback from the real customers handling, applying, and harvesting every year. The third-party contract research provides large-scale support over many geographies for product performance each year and opportunities for publication through peer-reviewed journals and media outlets. The local data is the foundation which the dealer and distributor-level sales teams utilize to promote in their own trade areas, carrying more weight locally than even the best third party or university data.
Cited References


Appendix

Chart 1. Average yield increase for all third-party replicated field trials on corn and wheat during 2004-2013 (231 locations).

![Average Yield Difference Chart]

Chart 2. All replicated corn field data via third party and on-farm during 2004-2014 (254 locations).
Chart 3. All replicated wheat field data via third party and on-farm during 2007-2012 (42 locations).

Chart 4. All replicated cotton field data via third party and on-farm during 2007-2013 (12 locations).
Chart 5. All replicated field data for all crops evaluated via third party and on-farm during 2004-2014 (475 locations).

Chart 6. The effects of UAN placement and rate with and without NutriSphere-N on Corn Yield (Mulford, 2005)
Chart 7. Corn yield response from UAN untreated or treated with NutriSphere-N (0.5% w/w) applied at two rates (VLS Studies, 2014).