

# Next Gen Fertilizer Challenges for Agronomic & Environmental Benefits



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# Essential Goal of Agriculture

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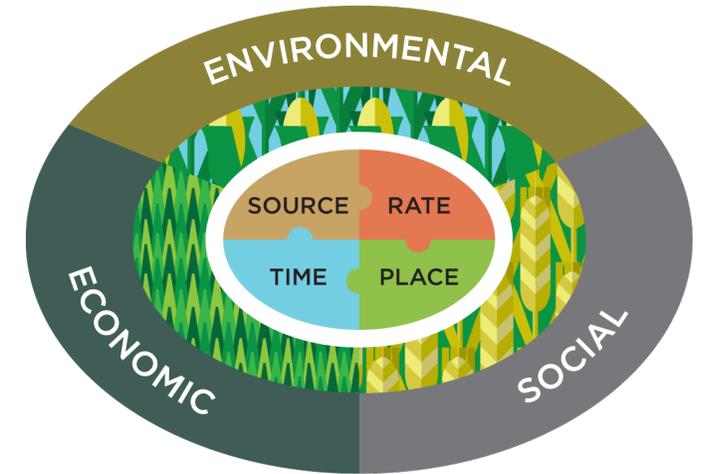
- **Simultaneously improve productivity & efficiency**
  - › Increasing societal demands
  - › Managing financial stress
  - › Addressing impact of production on air and water quality



- **Efficiency without productivity**
  - › Increases pressure to use marginal lands
- **Productivity without efficiency**
  - › Squanders resources & increases environmental impact

# 4R Nutrient Stewardship

- Improve agricultural production while contributing to social well being and minimizing environmental impacts (benefits water and air quality)



## RIGHT SOURCE

Matches fertilizer type to crop needs.



## RIGHT RATE

Matches amount of fertilizer to crop needs.



## RIGHT TIME

Makes nutrients available when crops need them.



## RIGHT PLACE

Keeps nutrients where crops can use them.

# 4R on the Farm

- Spring soil sample, 2.5 acre grid
- Spring apply stabilized N, 70% side dressed in-season at V10
- VRT apply P & K per soil maps
- All equipment has GPS, yield monitors, VRT & auto shutoff
- Determine N rate using yield & soils data integrated with in-season assessment



- Of farm research trials to test new products & practices
- 80% of acres are no-till
- Buffer strips, dry dams and grassed waterways in place as needed

# Environmental Metrics– IL Corn

	2014	2015	2016	2017
4R Practice Level	Basic	Basic	Intermediate	Advanced
Corn Grain Yield (bu/ac)	229	220	246	256
N Application Rate (lbs/ac)	253	208	253	204
Nitrogen Use Efficiency (lb N applied/bu corn grain)	1.11	0.95	1.03	0.80
N Balance (lb N applied – lb N harvested)	69.5	31.9	56.6	-1.14
CO2e Emissions per bu	9.4	8.43	8.17	6.14
Percent reduction	-	10.3	13.1	34.7

# Research

Research investment leads to innovations and improved fertilizer products, practices, and technologies. Research also allows for the evaluation of 4R practices' impact on crop yield and understanding their benefits for reducing fertilizer loss to the water and air.

**\$27.3M**

spent on research and development of innovative products and 4R practices.

**1.2M**

In 2018, the fertilizer industry contributed \$1.2 million to the 4R research fund

2018 industry data indicates  
**24% of all N sold and 11% of all P sold**  
by ag retailers was applied with an EEF

# Fertilizer Innovation

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- Nitrification and urease inhibitor use with UAN or AA decreases N<sub>2</sub>O and NO<sub>3</sub> losses
  - > R. Cook. Meta-analysis of Enhances Efficiency Fertilizers in Corn Systems in the Midwest. 2015
- Nitrification inhibitors reduced N<sub>2</sub>O loss by 31%
  - > A. Eagle et al. Fertilizer Management and Environmental Factors Drive N<sub>2</sub>O and NO<sub>3</sub> Losses in Corn: A Meta Analysis; Soil Sci. Soc. Am. J. 81:1191–1202
- Urease inhibitors with and without nitrification inhibitors decreased N<sub>2</sub>O emissions by 19-48%
  - > R. Omenode et al. Achieving Lower Nitrogen Balance and Higher Nitrogen Recovery Efficiency Reduces Nitrous Oxide Emissions in North America's Maize Cropping Systems; Frontiers in Plant Science 8:1080
- Polymer coated urea can reduce N<sub>2</sub>O emissions by 34% and has been shown to reduce NO<sub>3</sub> loss in corn
  - > Halvorson et al. Nitrogen source effects on nitrous oxide emissions from irrigated no-till corn. Journal E. Quality Sep-Oct 2010;39(5):1554-62
  - > Blaylock et al. ESN (R) controlled-release nitrogen for enhanced nitrogen efficiency and improved environmental safety. Abstracts of Papers of the American Chemical Society 228:U107.

# Next Gen Fertilizer Challenges

- To accelerate the development and use of existing and new technologies for corn production that maintain or increase crop yields affordably and reduce environmental impacts to air, land, and water.



# Public Private Partnership

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TFI members advance development and use of technologies and scientifically based management for cropping systems to meet sustainability goals, and the Challenges stimulate greater innovation and greater attention on the value of EEFs and other product technologies.



IFDC looks forward to hearing from the next generation of innovators destined to help our nation's farmers feed a growing population, while also protecting our lands, waters and air.



NCGA promotes sustainable farming practices that build soil health and to improve productivity and profitability while preserving natural resources. We hope to see increased adoption of technologies that will reduce the environmental impacts of corn production and improve our growers' profitability.



TNC seeks to demonstrate that environmental protection, food and nutrition security, and farm profitability can be achieved without compromises or tradeoffs, creating a win-win for all.

# EEF Agronomic & Environmental Challenge

**Goal: Identify existing EEFs that meet or exceed environmental and agro-economic criteria**

**Scope: EEFs already on- or near-market**

- **Stage 1:**
  - › Solvers submit information describing EEF and how it meets the requirements
  - › Submissions reviewed by expert judging panel
  - › Winners receive recognition and potentially advance to Stage 2
- **Stage 2:**
  - › Subset of solutions participate in greenhouse testing
- **Stage 3:**
  - › Plans for field trials



# Technical Requirements

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- **Must improve environmental performance by reducing nutrient losses to the environment through any combination of**
  - › Reduced NH<sub>3</sub> volatilization
  - › Reduced N<sub>2</sub>O emission
  - › Reduced N/P runoff or leaching
- **Must improve agronomic performance by**
  - › Not reducing yield
  - › Not increasing net farm costs in terms of return on investment (ROI)
- **Larger improvements will receive higher ratings**
- **Must be applicable to corn in the United States**
- **Must be an EEF on the market or near-market**
- **Must be compatible with current farming machinery**

# Next Gen Fertilizer Challenge

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**Goal: Identify next generation concepts for novel technologies**

**Scope: EEFs not near market or other novel technologies for fertilizers and product technology innovations**

**Process:**

- **Expert judging panel will review submissions and recommend winners**
- **\$65,000 prize pool and invitation to showcasing**



# Technical Requirements

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  - › Reduced NH<sub>3</sub> volatilization
  - › Reduced N<sub>2</sub>O emission
  - › Reduced N/P runoff or leaching
- **Must improve agronomic performance by**
  - › Not reducing yield
  - › Not increasing net farm costs in terms of return on investment (ROI)
- **Larger improvements will receive higher ratings**
- **Must be applicable to corn in the United States**
- **Must not be an EEF already on market or near-market;**
- **Must ultimately be compatible with current agricultural machinery and practices used for common large-scale production such as planters, fertilizer applicators or tillage equipment.**

# Where Will Next Gen Take Us?

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## **Biostimulants:**

Substance or microorganism that when applied to seeds, plants, or the rhizosphere stimulates natural processes to enhance or benefit:

- nutrient uptake,
- nutrient use efficiency,
- tolerance to abiotic stress, or
- crop quality and yield.

## **Enhance N Fixation:**

Thru crop genetics or microbial action

## **New Formulations:**

- Promote increased soil microbial diversity and require soil ecosystem services (bacteria, archaea, eukaryotes [fungi, root exudates]) for “control” release.
- Protect nutrients to eliminate leaching, runoff, and GHG emission
- Protect nutrients and reduce “unavailability”
- Lower production cost and environment footprint



# Supporting Actions

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- Support EEF and other amendment inclusion in ARMS and Ag Census questionnaires to better assess on farm use and environmental impact.
- Support policies that reduce regulatory barriers and provide incentives to develop new cost-effective technologies and best practices to reduce the industry's GHG footprint.
- Supports a uniform national framework that can be utilized by States to harmonize regulatory approval of current and other innovative plant nutrition products.
- Advocate for legislative amendments exempting biostimulants and removing nitrification inhibitors from the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).
- Pursue a streamlined FIFRA registration process allowing new nitrification inhibitors access to the market with reduced regulatory and resource requirements.



**There is no silver bullet.**

# One Final Thought

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## Nutrient Use Efficiency (ratio removal / input)

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- **World**                    **0.585**
- **EU (central)**        **0.559**
- **USA**                     **0.740**
- **4R Advocates** **1.116**

## Corn Yield (bu/ac)

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- **World**                    **90**
- **EU (central)**        **152**
- **USA**                     **173**
- **4R Advocates**        **203**



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INSTITUTE

# Questions

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