Next Gen Fertilizer Challenges for Agronomic & Environmental Benefits

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Essential Goal of Agriculture

- 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)
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

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

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

$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.
Fertilizer Innovation

• Nitrification and urease inhibitor use with UAN or AA decreases N$_2$O and NO$_3$ losses
  › R. Cook. Meta-analysis of Enhances Efficiency Fertilizers in Corn Systems in the Midwest. 2015

• Nitrification inhibitors reduced N$_2$O loss by 31%

• Urease inhibitors with and without nitrification inhibitors decreased N$_2$O emissions by 19-48%

• Polymer coated urea can reduce N$_2$O emissions by 34% and has been shown to reduce NO$_3$ loss in corn
  › 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.

USDA
EPA
The Fertilizer Institute
IFDC
National Corn Growers Association
The Nature Conservancy
Public Private Partnership

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.
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

• Must improve environmental performance by reducing nutrient losses to the environment through any combination of
  › Reduced NH3 volatilization
  › Reduced N2O 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

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

• Must improve environmental performance by reducing nutrient losses to the environment through any combination of
  › Reduced NH3 volatilization
  › Reduced N2O 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?

Biostimulants:
Substance or microorganism that when applies 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.

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

Enhance N Fixation:
Thru crop genetics or microbial action
Supporting Actions

- 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

<table>
<thead>
<tr>
<th>Nutrition Use Efficiency (ratio removal / input)</th>
<th>Corn Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>World</td>
</tr>
<tr>
<td>EU (central)</td>
<td>EU (central)</td>
</tr>
<tr>
<td>USA</td>
<td>USA</td>
</tr>
<tr>
<td>4R Advocates</td>
<td>4R Advocates</td>
</tr>
<tr>
<td>0.585</td>
<td>90</td>
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<tr>
<td>0.559</td>
<td>152</td>
</tr>
<tr>
<td>0.740</td>
<td>173</td>
</tr>
<tr>
<td>1.116</td>
<td>203</td>
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</tbody>
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Questions
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