4R Stewardship Research Initiative
Fluid Forum, February 17, 2015
Scottsdale, AZ

Paul Fixen,
International Plant Nutrition Institute
Performance Indicators

**ECONOMIC**
- Profit
- Yield
  - Quality
  - Return on investment
- Resource use efficiencies:
  - Energy
  - Labor
  - Nutrient
  - Water

**ENVIRONMENTAL**
- Nutrient balance
- Nutrient loss
- Biodiversity
- Soil erosion
- Water & air quality
- Ecosystem services
- Nutrient loss
- Yield stability
- Soil productivity
- Farm income
- Nutrient loss
- Water & air quality
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**SOCIAL**
- Working conditions
- Affordable food
- Adoption

**Cropping system**
- Right Source at Right Rate, Right Time, Right Place
Purpose of the 4R Research Fund: To help develop data on the economic, environmental and social impact of 4R Nutrient Stewardship across North America.
• NA fertilizer industry pledged $7 M over 5 yrs
• To date: $2,494,000 has been collected
Technical Advisory Group (Chair: Paul Fixen)

**Industry**
- Melissa Bauer, Service Provider
- Greg Binford, Wilbur-Ellis
- Howard Brown, Growmark
- Kyle Freeman, The Mosaic Company
- Rigas Karamanos, Viterra/Koch
- Alexandre Mailloux, La Coop Fédérée
- Robert Mullen, Potash Corp
- Steve Petrie, Yara
- Greg Schwab, Koch Agronomics
- Terry Tindall, J.R. Simplot
- Yebin Zhao, CF Industries

**Government Agencies and Universities**
- Cynthia Grant, AAFC
- Daren Harmel, USDA ARS
- Newell Kitchen, USDA ARS
- Tim Hartz, UC-Davis
- Shannon Zezula, USDA NRCS
- Keith Reid, AAFC
- Ivan O'Halloran, University of Guelph
- Matt Helmers, Iowa State University

**Associations**
- Dave Coppess, IA Ag Clean Water Alliance
- Gail Hesse, Ohio Lake Erie
- Dan Schaefer, IL Council of BMPs
- Lara Moody, TFI (Ex-Officio)
- Dave DeGeus, Nature Conservancy
- Cliff Snyder, IPNI
- Scott Murrell, IPNI
- Clyde Graham, CFI (Ex-Officio)
Fund Management Committee (Chair: Lara Moody)

**Voting Members**
Doug Beever, Agrium
Steve Biggar, Richardson
Jeff Carr, United Suppliers
Jeff Holzman, Potash Corp
Bill Jackson, AgriServices of Brunswick
Michael Johnson, CHS
John Malinowski, J. R. Simplot
Mark Kaplan, The Mosaic Company
Rosemary O’Brien, CF Industries
Billy Willard, Willard Ag

**Non-Voting Members**
Terry Roberts, IPNI
Tom Christianson, USDA NRCS
Clyde Graham, CFI
Mark Walbridge, USDA ARS
Project Oversight

- Funding for the projects goes through the Foundation for Agronomic Research (FAR)
- An IPNI scientist oversees each project ... visits the research sites, work with the researchers, collect the reports, help disseminate information, etc.
Reviews and Meta-analyses Funded to Date ($273,000)

1. **Nutrient Stewardship on Drained Land** - Laura Christianson, The Conservation Fund
3. **Effects of Conservation & Fertilizer Application Methods on N & P Loss** - Song Qian, U. of Toledo
4. **P Placement & Tillage Interaction for Corn & Soybean** - Dorivar Ruiz Diaz, KSU
5. **4R Fertilizer Management to Address Nitrous Oxide and Nitrate Losses in U.S. Corn-based Systems** - Alison Eagle, Duke U.

Progress or final reports due end of February
Example of results from “4R Fertilizer Management to Address Nitrous Oxide and Nitrate Losses in U.S. Corn-based Systems” - Alison Eagle, Duke University

- Very few studies report yield and both NO$_3^-$ and N$_2$O losses
- Source comparisons in ½ the N$_2$O studies but only 1 NO$_3^-$ study
- Placement or timing compared in 15-19% of cases
Figure 3. Results from meta-analyses for side-by-side comparisons of \( \text{N}_2\text{O} \) emissions following various N and cropping system management practices. Numbers in parentheses indicate the number of observations on which the analysis was based, and the number of different field sites from which the observations originated. Error bars denote 95% confidence intervals. Figure was created in R-project version 3.0.2.
Field Projects Funded to Date – U.S. ($2.1 mil over 5 yrs)

1. **Evaluating 4R Nutrient Stewardship & Certification in the W. Lake Erie Basin** – Kevin King, USDA-ARS

2. **Impacts of 4R on Crop Production & Nitrate Loss in Tile Drainage** – Matt Helmers, ISU

3. **Late-vegetative N App. for High-yield Corn: Hybrid Implications** – Tony Vyn, Purdue

4. **Minimizing P Loss with 4R Stewardship & Cover Crops** – Nathan Nelson, KSU
H-flume instrumented for continuous measurement of runoff and automated collection of water samples
Field Projects Funded in Canada ($150,000 as Canadian bridge funding in 2014)

1. **N stabilizers to enhance NUE and reduce GHG emissions** – Dr. Linda Hall, U of A
2. **Coordinated N and S management in Sulfur-deficient soils** – Dr. Miles Dyck, U of A
3. **Effect of broadcast vs banded P on fate of applied P in soil and in snowmelt water flow** – Dr. Jeff Schoenau, U of S
4. **Limiting loss of fall applied N fertilizer using EEFs** – Dr. Mario Tenuta, U of M

1. **Improving N management tools for reduced environmental losses from corn production** – Dr. Claudia Wagner-Riddle, U. of Guelph
2. **Improved N application methods and N sources for corn in SW ON** – Dr. Craig Drury, AAFC in Harrow, ON
3. **Optimization of N fertilization in response to production uncertainties under 4R Nutrient Stewardship** – Dr. Nicolas Tremblay, AAFC in St-Jean-sur-Richelieu, QC
4. **Can the use of in-season foliar urea increase NUE and reduce N losses in potato production in Atlantic Canada** – Dr. David Burton, Dalhousie U

**Progress summaries due end of February**
Stated in Fund RFPs and project agreements: “Data generated by 4R Fund projects must be submitted for inclusion in an open access 4R Fund project database, in a format that will be subsequently determined and prescribed.”

Making the Case for Evidence-based Agriculture

- Strives to round up and evaluate all high quality data on the efficacy of practices and apply the synthesized findings to crop care
- Systematic reviews of literature and meta-analyses
- Publishing and curating high quality, open-access data sets

CSA News, May 2014
Status of 4R Research Fund Data Repository

• Proposal in late stages of development
  – Dr. Sylvie Brouder, Purdue U.
  – A standard data repository and preservation framework for 4R Fund projects
  – Assistance to funded projects with data submission

• Housed within the Purdue University Research Repository (PURR) managed by Purdue Libraries
  – Budget remains in preparation
  – Project duration of 18 months
http://research.ipni.net/toc/category/4r_research_fund
Evaluating 4R Nutrient Stewardship & Certification in the W. Lake Erie Basin – Dr. Kevin King, USDA-ARS ($1.2 M from 4R Fund + $3.2 M in external funding)

**Collaborators:**
- 11 principal/co-principal investigators

**Goal:** evaluate impacts of the adoption of 4R practices and the 4R Certification Program on crop productivity and profitability, water quality, and perceptions of growers, nutrient service providers, and residents of the Basin
Evaluating 4R Nutrient Stewardship & Certification in the W. Lake Erie Basin – Dr. Kevin King, USDA-ARS ($1.2 M from 4R Fund + $3.2 M in external funding)

- Data collection from edge-of-field scale
- Date collection from watershed scale
- Watershed and in-lake modeling

Outline of fields in Ohio (A and B) and Indiana (C) to be used for edge-of-field monitoring
Evaluating 4R Nutrient Stewardship & Certification in the W. Lake Erie Basin – Dr. Kevin King, USDA-ARS
($1.2 M from 4R Fund + $3.2 M in external funding)

• Status: Instrumentation of the edge-of-field sites is well underway. Watershed water quality data is being collected.

• Previous producer surveys are being evaluated and additional surveys for both producers and retailers are being developed.

• Outreach and promotion of the 4R program have occurred at multiple meetings and venues.
What’s next?

• Establishment of the 4R data repository

• Planning a 4R summit with researchers who conducted the reviews/meta-analysis the week of May 11, 2015 to
  – Present their findings and gaps identified
  – Provide an opportunity to leverage funds ... states with tonnage taxes, crop commodity groups with check off dollars, EPA, ARS, and NIFA will be invited

• Additional call for projects once priority gaps are identified

The 4R Fund and supported projects continue to be relevant and important to the fertilizer industry ...
Mississippi River Basin – All or Parts of 30 States

Major U.S. Fertilizer Consumption

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<th>MRB as % of U.S. (2012)</th>
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<tr>
<td>N</td>
<td>88</td>
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<tr>
<td>P₂O₅</td>
<td>92</td>
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<tr>
<td>K₂O</td>
<td>86</td>
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</tbody>
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Graphic Source: NOAA

IPNI
USGS SPARROW Modeled Sources of Annual N Load to Gulf of Mexico

Des Moines Water Works sues 3 counties over high nitrate levels in the Raccoon River

- Filed in federal court under the U.S. Clean Water Act, which grants regulatory exemptions to nonpoint source discharges, including field tile systems
- Waterworks officials say organized drainage districts shouldn't be exempt from regulations

Adds to relevance of “Impacts of 4R on Crop Production & Nitrate Loss in Tile Drainage – Matt Helmers, ISU”
Mississippi River Basin States with Nutrient Loss Reduction Strategies

- Arkansas
- Indiana
- Illinois
- Iowa
- Louisiana
- Kentucky
- Minnesota
- Mississippi
- Missouri
- Ohio
- Wisconsin

• Tennessee (coming soon)

http://water.epa.gov/type/watersheds/named/msbasin/nutrient_strategies.cfm
Subsoil Phosphorus Loss

A complex problem with no easy solutions

by Madeline Fisher

• Included Lake Erie problems
• P loss via tile drains a significant contributor
• 4R project should offer import science-based guidance
Thanks for your support of the 4R Fund

Research fund contributors are listed below. If you would like to contribute to this effort please contact Lara Moody, Director of Stewardship Programs for TFI (lmoody@tfi.org).