Welcome to *The Current*, the North Central Region Water Network's Speed Networking Webinar Series

Winter Manure Application and Water Quality: 2PM CT

1. Submit your questions for presenters via the Q&A panel. There will be a dedicated Q&A session following the last presentation. The Q&A panel can be found via the Q&A icon at the bottom of the webinar screen.
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This session will be recorded and available at northcentralwater.org.

Today's Presenters:

- **Daniel Andersen**, Associate Professor, Manure Management and Water Quality, Iowa State University
- **Melissa Wilson**, Assistant Professor, Department of Soil, Water and Climate, University of Minnesota
- **Todd Trooien**, Natural Resources Engineer, South Dakota State University Agricultural and Biosystems Engineering

Follow @northcentralh2o and #TheCurrent on Twitter for live tweets!

Daniel Andersen

Dr. Daniel Andersen is an associate professor and extension specialist in the Agricultural and Biosystems Engineering Department at Iowa State University. Dr. Andersen's research interests are manure management, water quality, and anaerobic digestion. He works on nutrient management planning, field and farm-scale soil and water quality monitoring, and evaluating sustainable agricultural practices related to carbon, nitrogen, and phosphorus cycles. His extension program focuses on helping farmers and consultants make informed financial and environmental decisions that lead to a more sustainable future.

Liquid versus solid winter-applied dairy manure

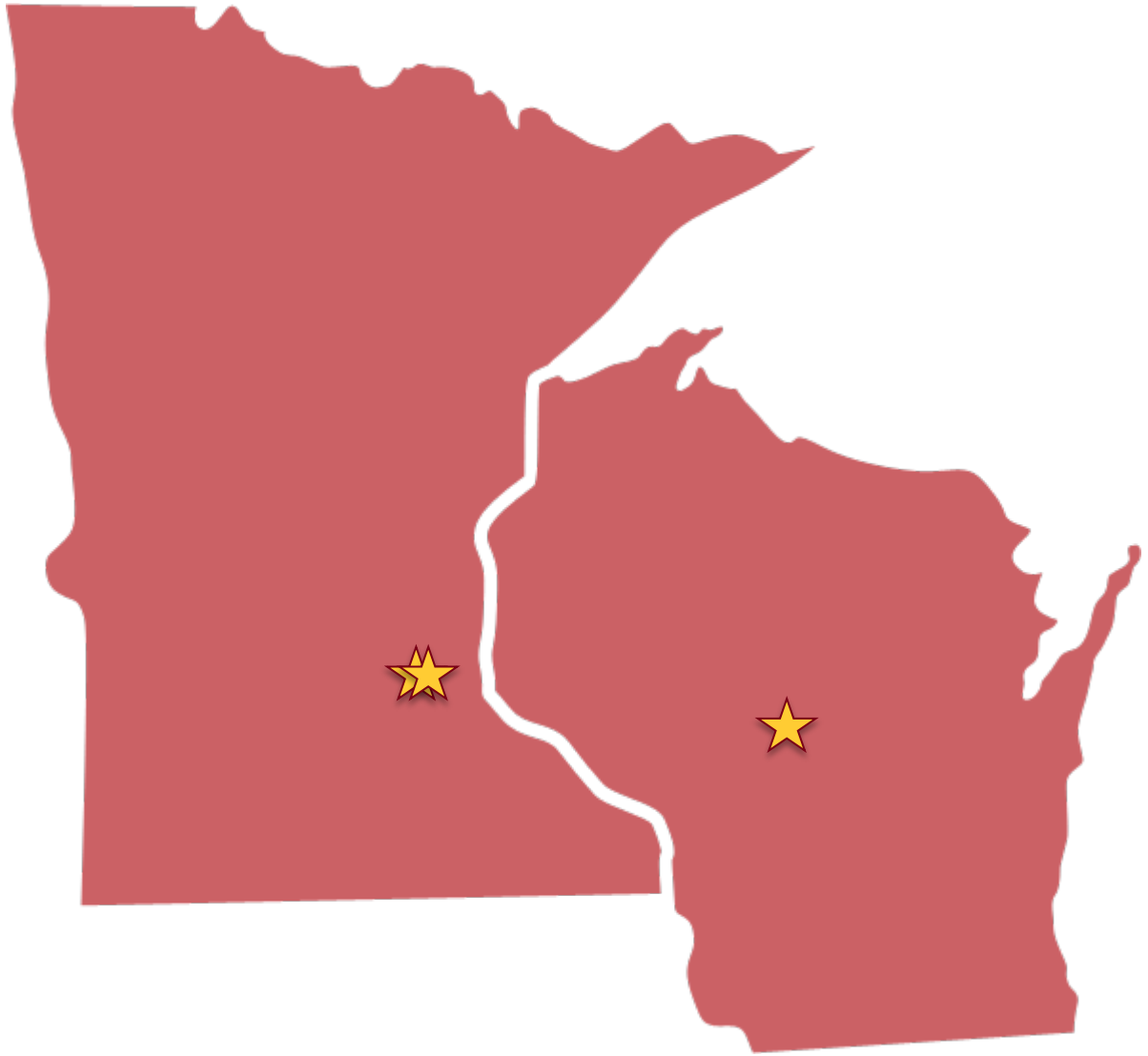
Melissa Wilson, Assistant Professor, University of Minnesota

What did we do?

- Took a dairy manure and diluted it to various solids contents
- Applied it on top of snow
- Measured nutrients in runoff

Locations

- Three site years total
  - 2018 in Saint Paul, MN
  - 2019 in Saint Paul, MN and Marshfield, WI



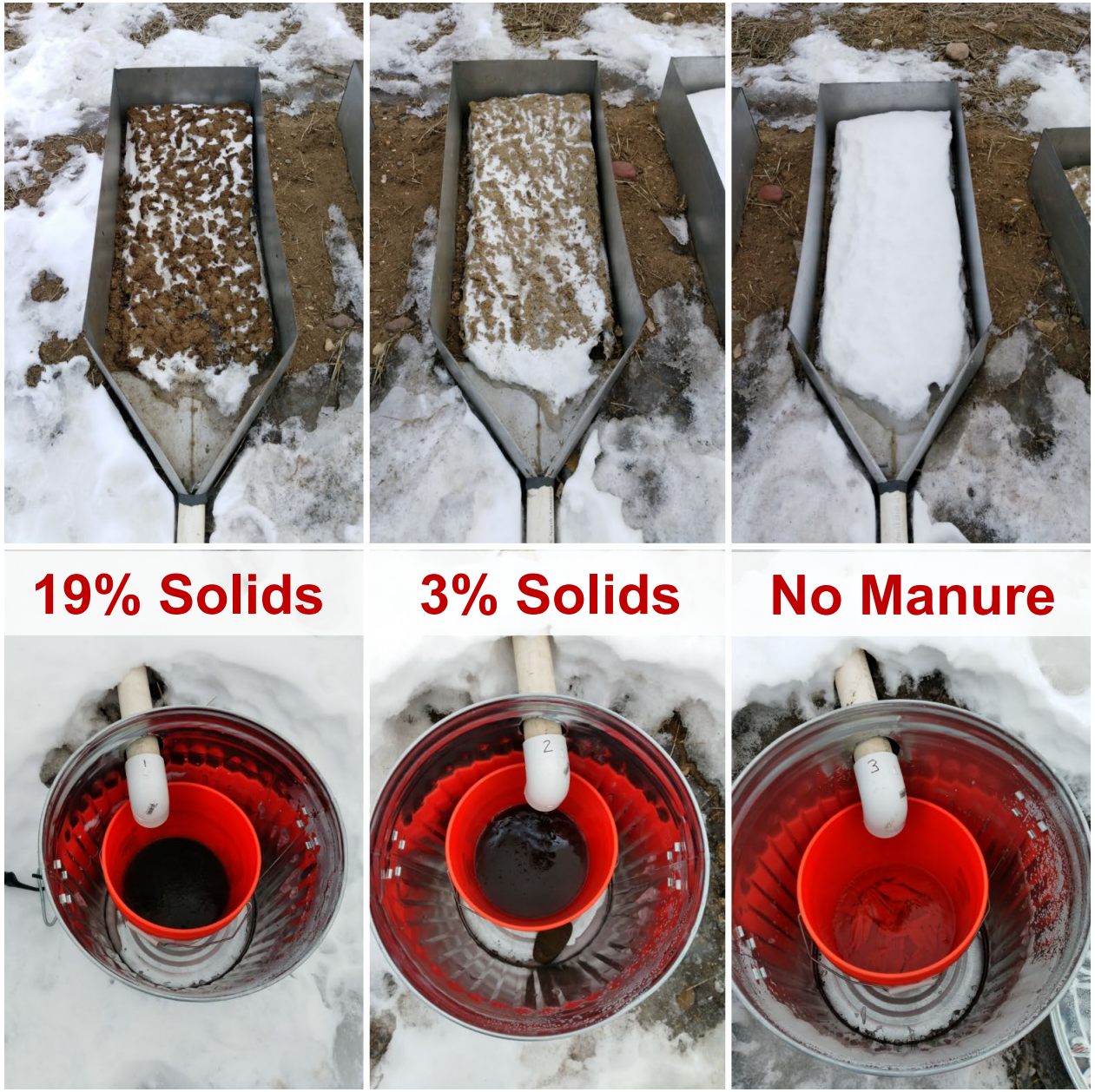
Winter manure applications

- High solids: 13-19% solids
- Medium solids (only at WI site): 8% solids
- Low solids: 3-5.5% solids
- Control: no manure

First runoff event in 2018

Manure applied at Saint Paul site January 24, 2018

Collected samples: Jan. 28, 2018

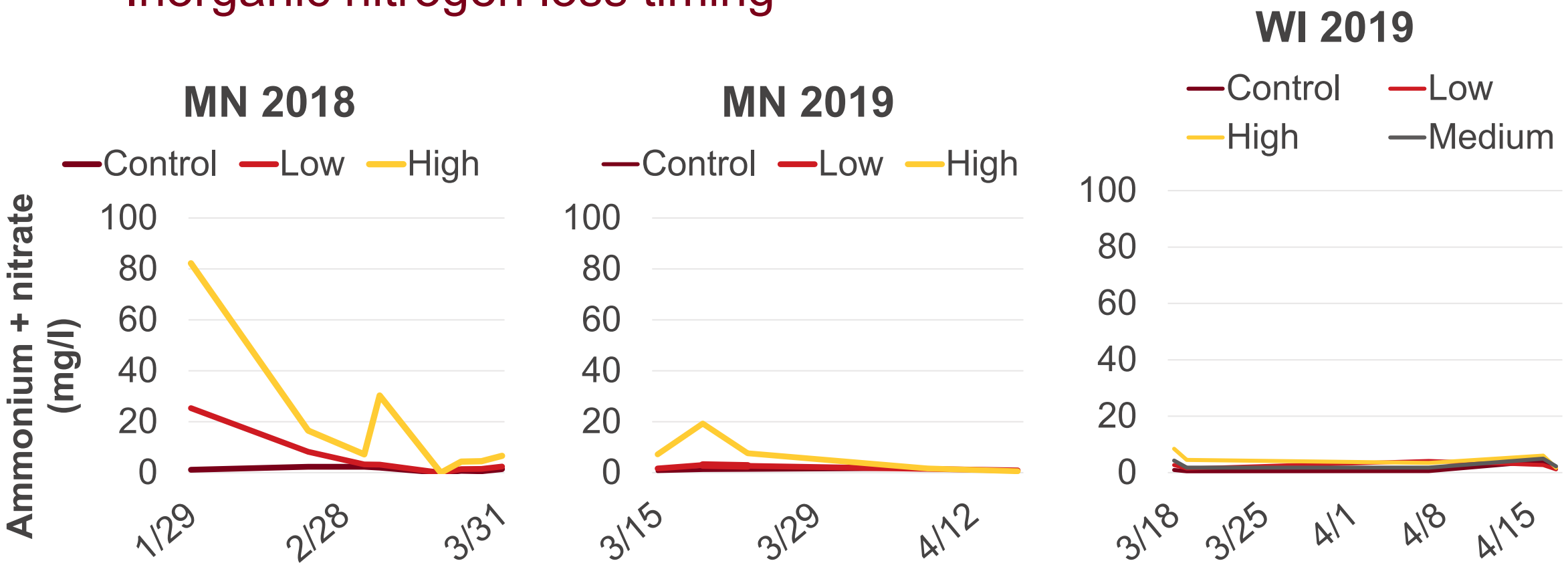


Third runoff event

Collected samples mid-event after a rainfall:
Mar. 4, 2018

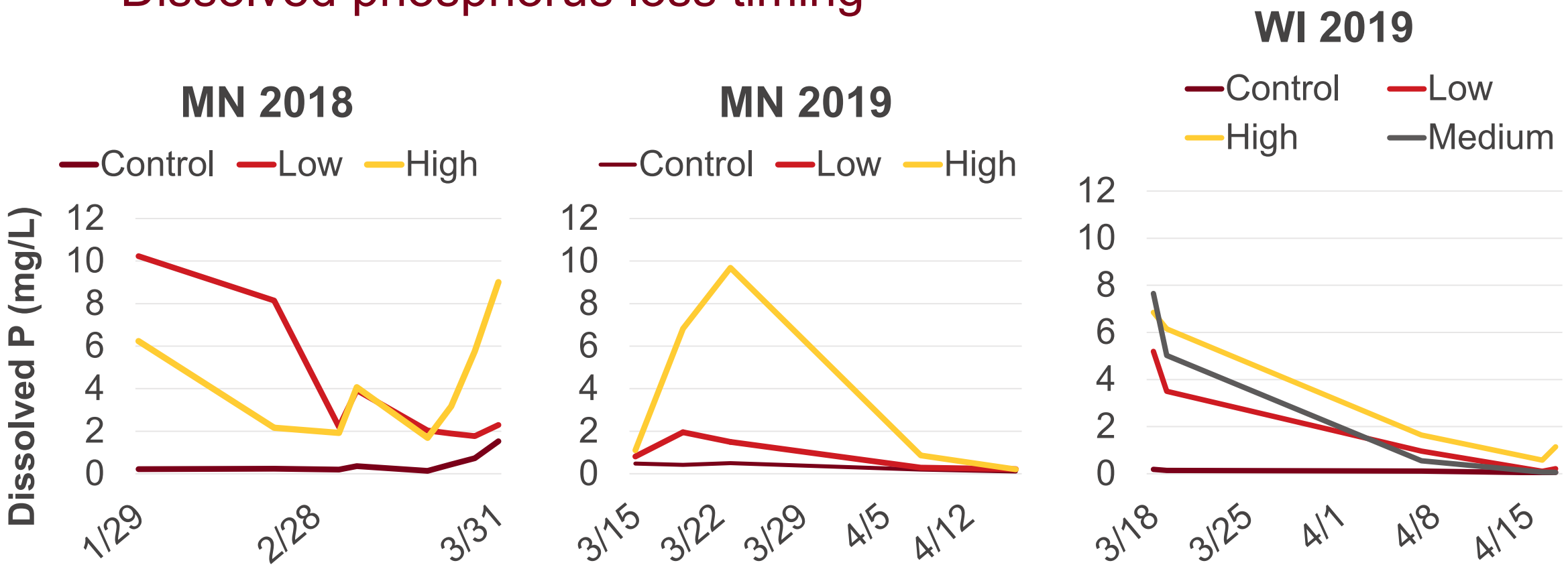
Winter Runoff Nutrient Losses

- Inorganic nitrogen loss timing



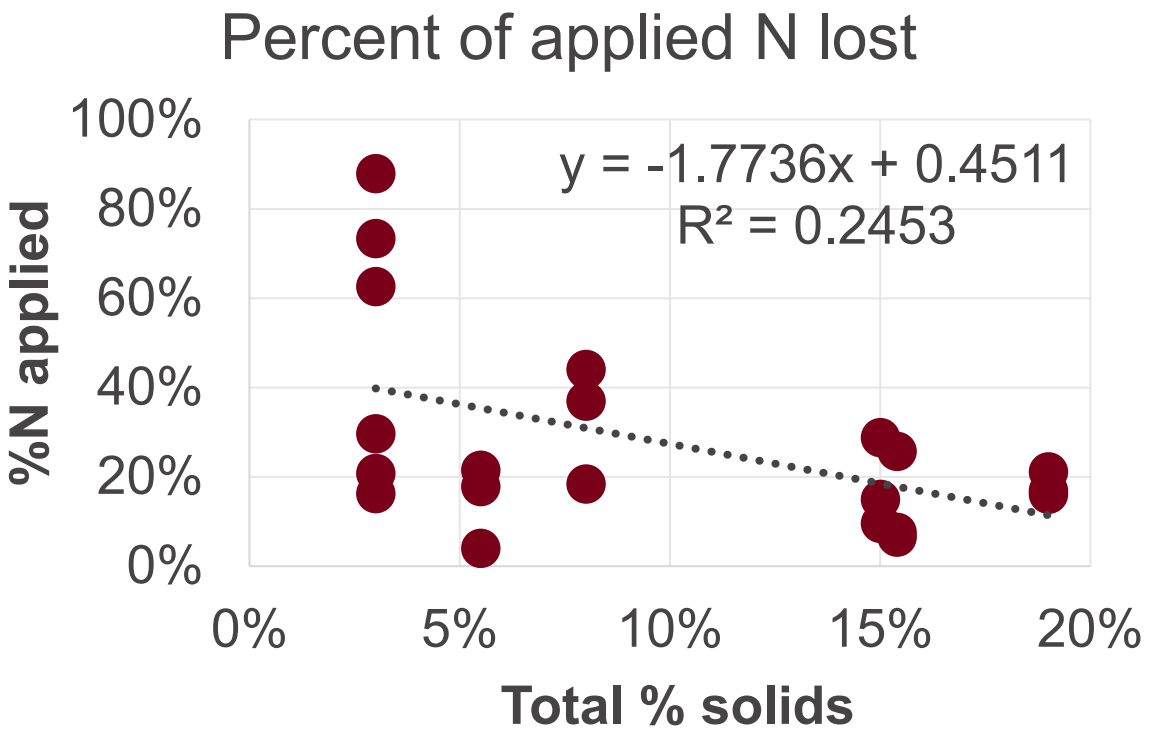
Winter Runoff Nutrient Losses

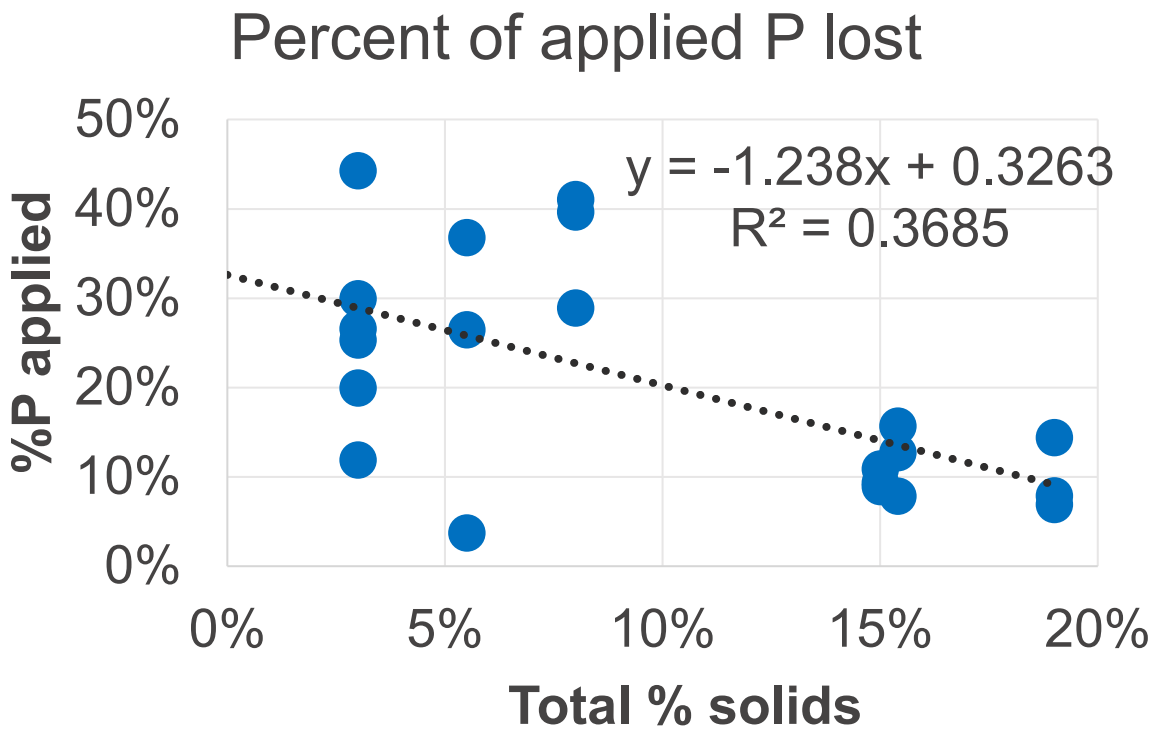
- Dissolved phosphorus loss timing



Winter Runoff Nutrient Losses

- Cumulative nutrient losses through the end of March





Thank you!

Special thanks to my staff and students!

Contact Info: mlw@umn.edu

- Follow me on twitter @ManureProf
- z.umn.edu/manureresearch2021

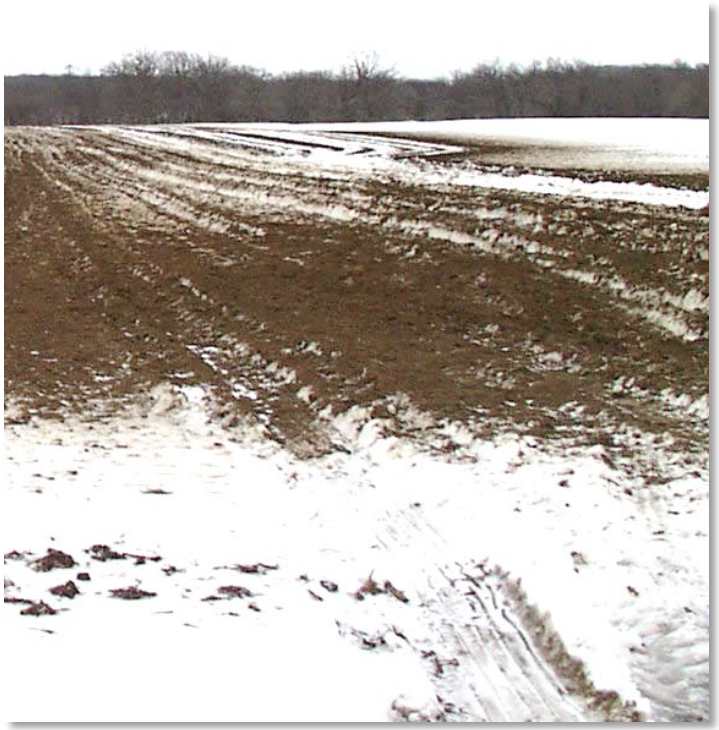
Melissa Wilson

Dr. Melissa Wilson is an assistant professor and Extension specialist in manure nutrient management at the University of Minnesota. Her research and extension programs focus on optimizing land application of manure while protecting water quality.

Winter Manure Application Best Practices

IOWA STATE UNIVERSITY
Extension and Outreach

Why would you apply in Winter?



- Emergency
  - Equipment failure
  - Broken water line
- Compaction
- Timeliness
- Odor issues
- Lower bacteria survival
- Lack of storage capacity

Why wouldn't you?

- Legalities
  - NPDES permit terms
  - CNMP contract terms
  - State laws
- Increased nutrient loss risk?
- Increased pathogen survival?
- What does research say?

Research results from 11 studies from 1935 to 2008 agree

- High runoff from rain or snowmelt from frozen ground pose high nutrient loss risk
  - Especially catastrophic events
- Runoff events sooner after application pose higher risk

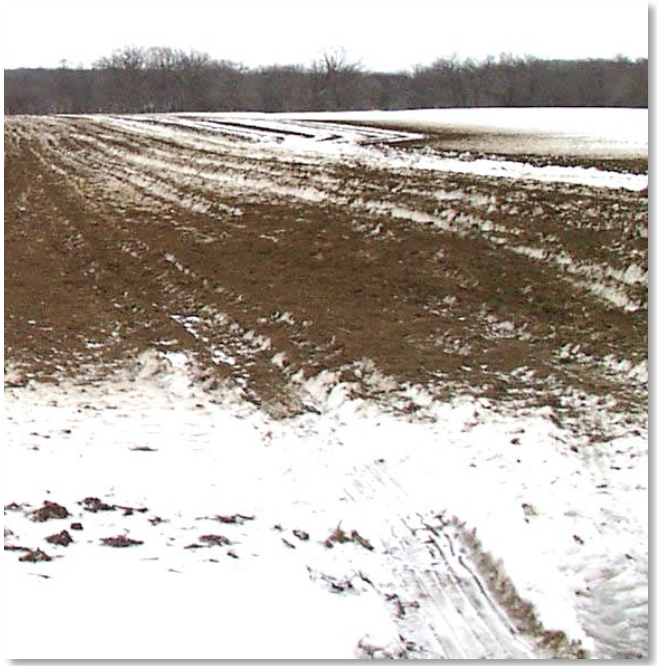
Research results from 11 studies from 1935 to 2008 mixed

- Land slope may/may not increase risk, zero slope best
- Frozen ground does not always mean zero infiltration
- Manure under snow may/may not be better than on top of snow

Hydrology of Frozen Soils

- Soil structure influenced by soil organic matter and soil moisture
- 4 structures (concrete, honeycomb, stalactite, and granular)
- Concrete structure – freezing and thawing breaks up surface soil aggregates, and freezes
- Concrete structure comes from wetter soils at time of freezing, free thaws
- Apply early winter before soil structure is challenged (and drier soils)
- As time progresses look for fields that maintain structure better - grass

Research results from 11 studies from 1935 to 2008 mixed



- E. coli survival is better in cool water than warm
- Freezing is usually lethal to E. coli
- Some other pathogens
  - Cryptosporidium
    - Survive well even below freezing

What we know, bottom line

- Manure nutrients exposed to runoff water flow move easily
- Risk is dependent on water flow
  - Snow depth, weather

This isn’t rocket science

This isn't even model rocket science.

What we can recommend

- Incorporate manure when you can
- Avoid areas of concentrated flow
  - Like waterways

What we can recommend

- Apply to land with low runoff risk
  - Either flat or good erosion/runoff control
- Apply to land that accumulates less snow
- Consider that high residue may help, or hurt
  - See two points above

What we can recommend

- Use setback distances or protection for sensitive areas
  - Stream banks
  - Sinkholes, etc.
- Or conduits to surface waters
  - Drainage tile intakes
  - Flow channels, etc.

What we can recommend

- Apply when significant runoff is least likely
  - Little snow exists
  - Favorable forecast

Plus, remember any regulations or program rules

What comments do you have?

- Iowa Manure Management Action Group
  - www.agronext.iastate.edu/immag
- Daniel Andersen
- dsa@iastate.edu

References

- Impacts of Winter Spreading of Manure on Water Quality - Literature Review, Fleming & Fraser, University of Guelph, June 2000
- Extension Publications Providing Guidance on Winter Application of Manure and Fertilizer Nutrients, Rieck-Hinz, Iowa State University, IMMAG webpage

References

- Winter Manure Applications: Sound Practice or Risky Business?, Baxter, University of Wisconsin, presentation
- Minimizing risk when applying manure in winter, Lorimor, Iowa State University, Fall 1999 Odor and Nutrient Management Newsletter

Todd Trooien

Todd Trooien has been a Natural Resources Engineer in the Department of Agricultural and Biosystems Engineering at South Dakota State University since 2000. In that role, he gets to teach many different courses and dabble in a bit of research. In addition to the current winter manure/water quality work, he hopes to further the practice of using subsurface drip irrigation to apply effluent from animal production facilities.

Manure Application during the Winter

SDSU Research

February 2022

South Dakota State University
Department of Agricultural & Biosystems Engineering

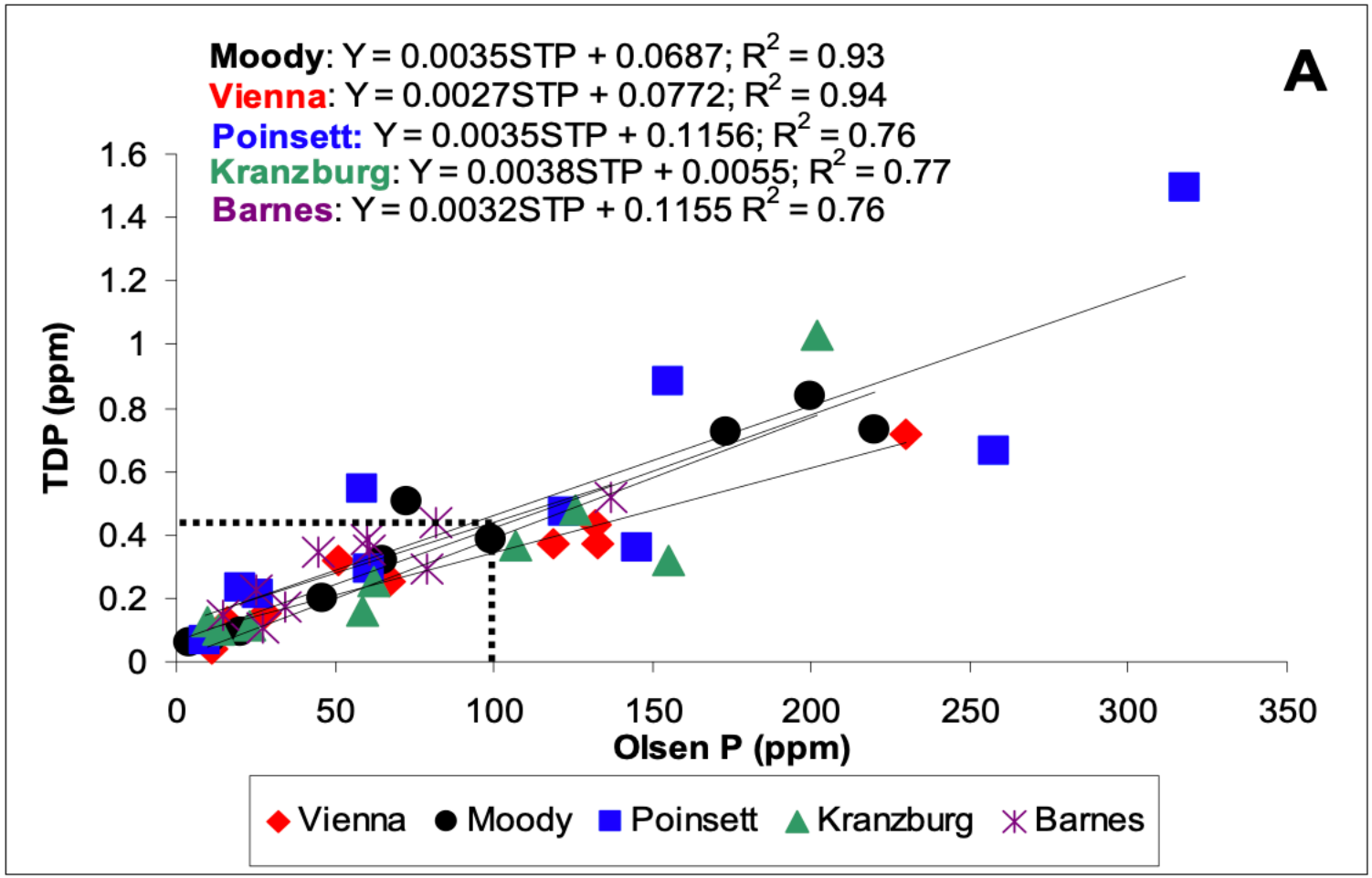
Acknowledgements

- David German
- Frank Schindler
- Jim Gerwing
- Ron Gelderman
- Dennis Todey
- Erin Cortus
- Jeppe Kjaersgaard
- Angela Guidry
- Ammar Bhandari
- Nathan Brandenburg
- Shikha Singh
- Bryce Siverling

Figure. 3. Rainfall simulator used for P runoff evaluations.

Image: Schindler et al, 2007

Image: Schindler et al, 2005



Schindler et al, 2005

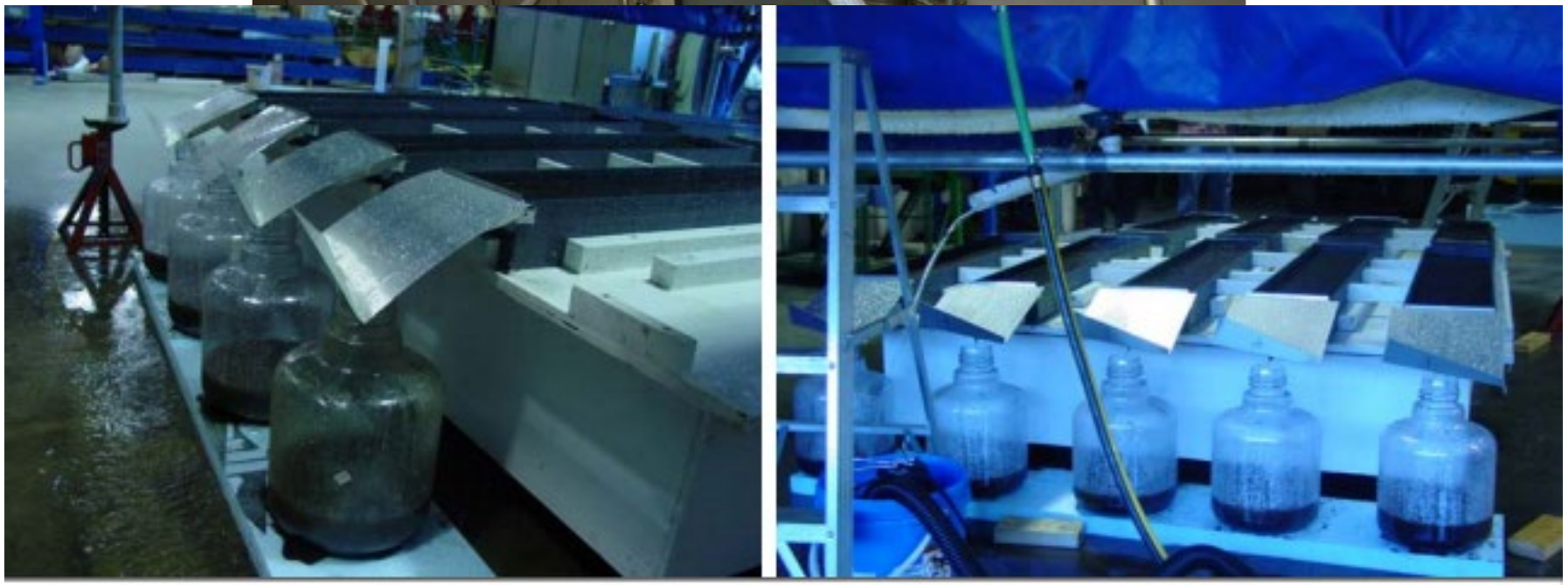


Figure 5. Surface runoff collection during indoor rainfall simulation.

Figure 4. Runoff boxes used for indoor rainfall simulation.

Images: Schindler et al, 2007

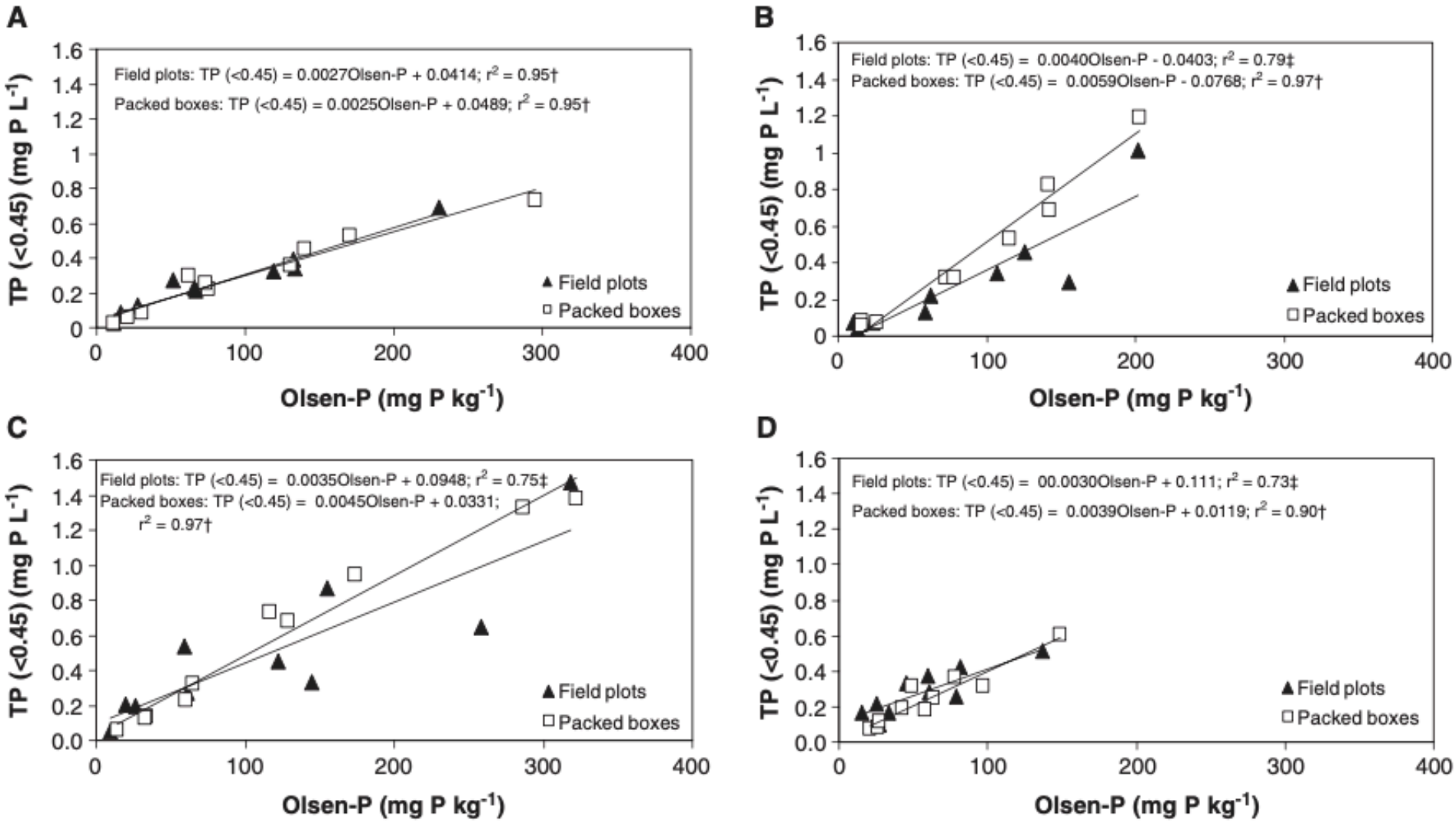
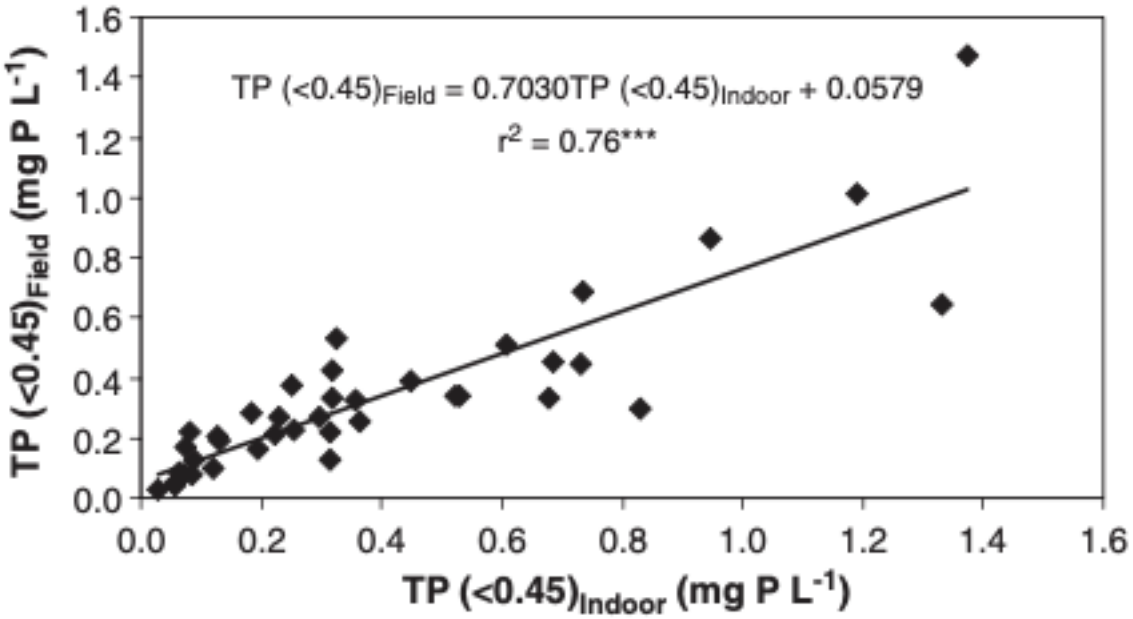


Fig. 1. Relationship between total dissolved P in runoff [TP(<0.45)] concentrations in surface runoff (mg P L^{-1}) and Olsen-P (mg P kg^{-1}) for simulation method and the (A) Vienna ($n = 10$), (B) Kranzburg ($n = 9$), (C) Poinsett ($n = 10$), and (D) Barnes ($n = 10$) soils. Olsen-P and surface runoff TP(<0.45) relationships for the field plots and packed boxes were based on 0- to 5-cm probe and bulk soil samples, respectively. † Regression significant at the $P = 0.0001$ probability level. ‡ Regression significant at $0.001 < P < 0.002$ probability level.

Guidry et al, 2006

In summary, field vs lab:



Guidry et al, 2006

Plot study of snowmelt, manure

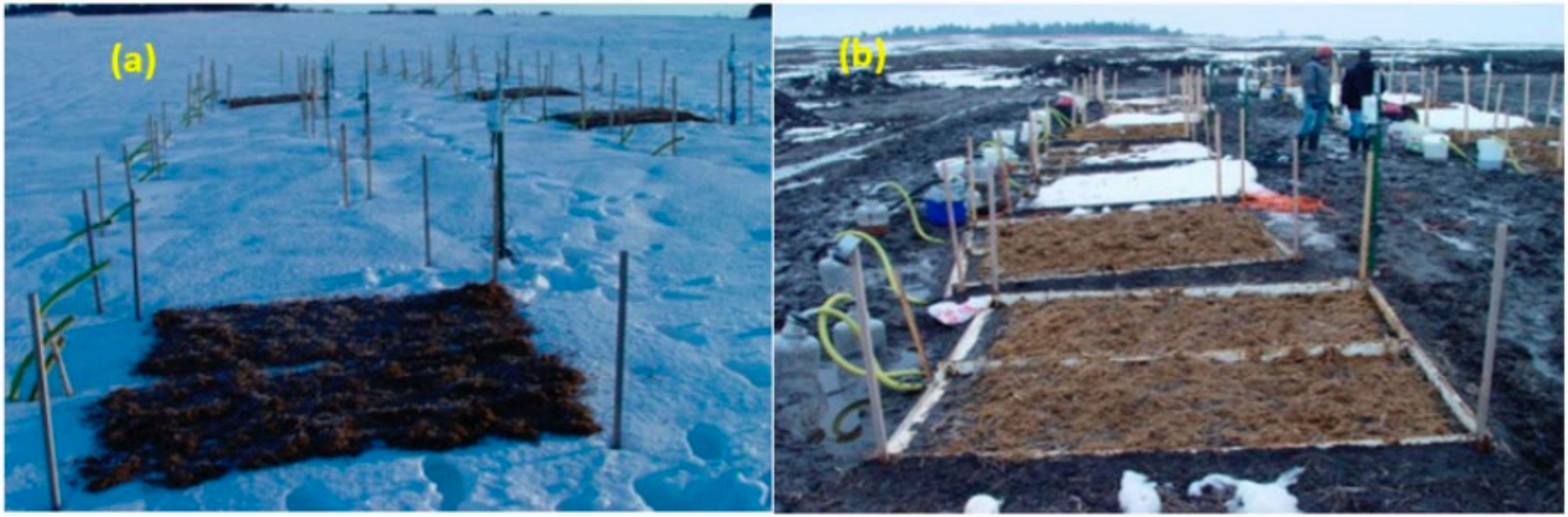


Figure 2. (**a**) Manure application in January 2010 (on top of snow); (**b**) snowmelt runoff collection in March 2010.

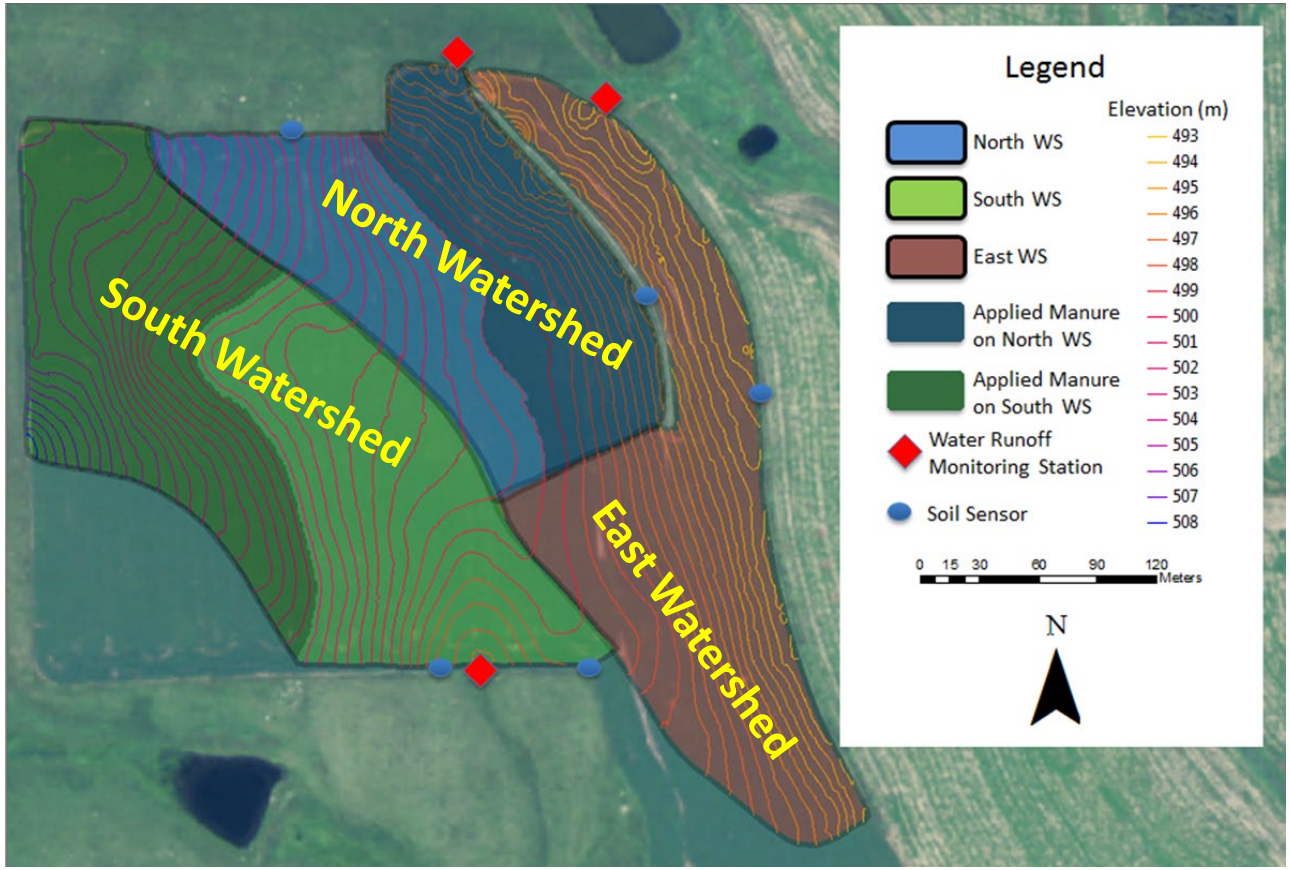
Bhandari et al, 2021

The study

- Manure was applied in November, January, or March
- Melt in mid-March

- Some responses but I'll leave the untangling to you (Bhandari et al., 2021)

Paired watershed study



Manure applications

Date	Crop	App Rate, ton/ac	Manure Source
6 March 2011	Soybean	6.0	Beef feedlot
16 February 2012	Corn	10.1	Beef feedlot
10 March 2013	Soybean	7.0	Beef feedlot
26 March 2014	Corn	18.0	Dairy
23 March 2015	Soybean	3.9	Dairy
22 April 2016	Corn	13.0	Beef feedlot
10 February 2017	Soybean	3.1	Beef feedlot
1 March 2018	Corn	16.0	Beef feedlot

Conditions varied

Spreading March 4-5 2011

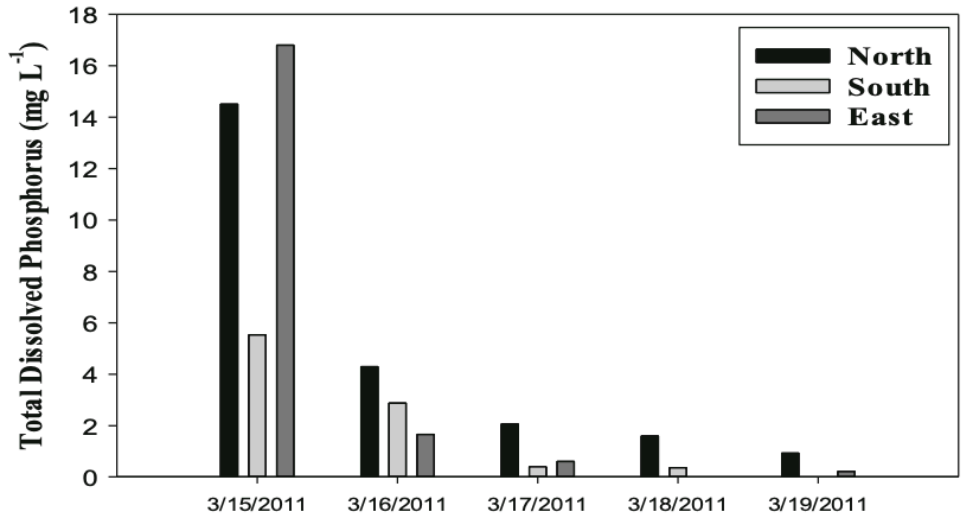
Spreading February 16-17 2012

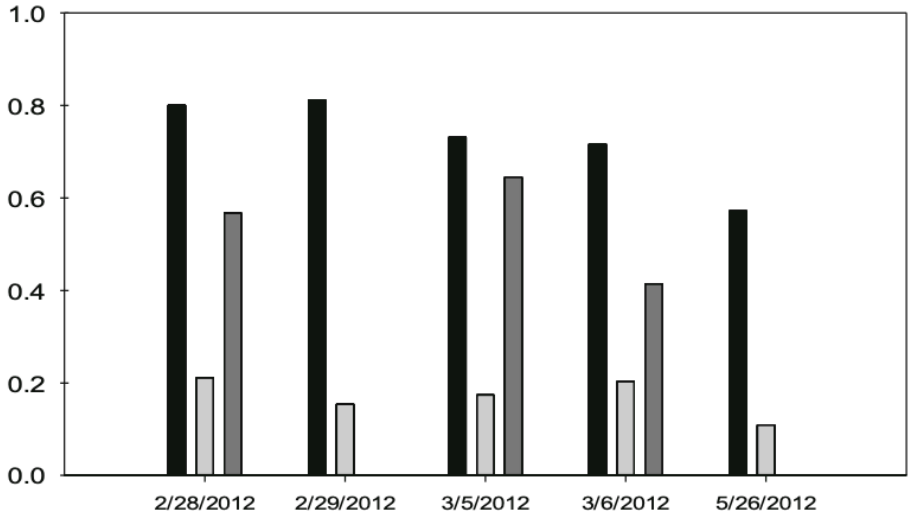
Old and New

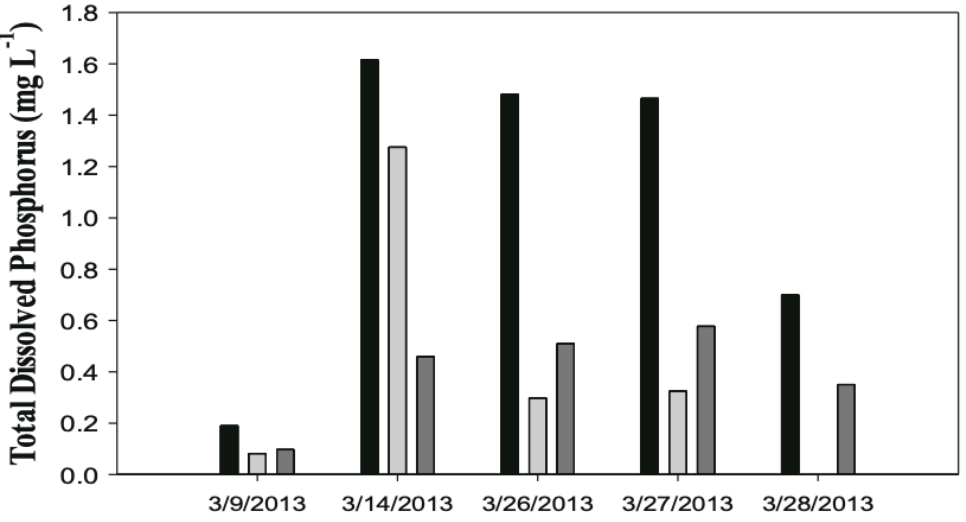
Figure 6. An H-Flume and stage recorder was used to monitor runoff at each WS.

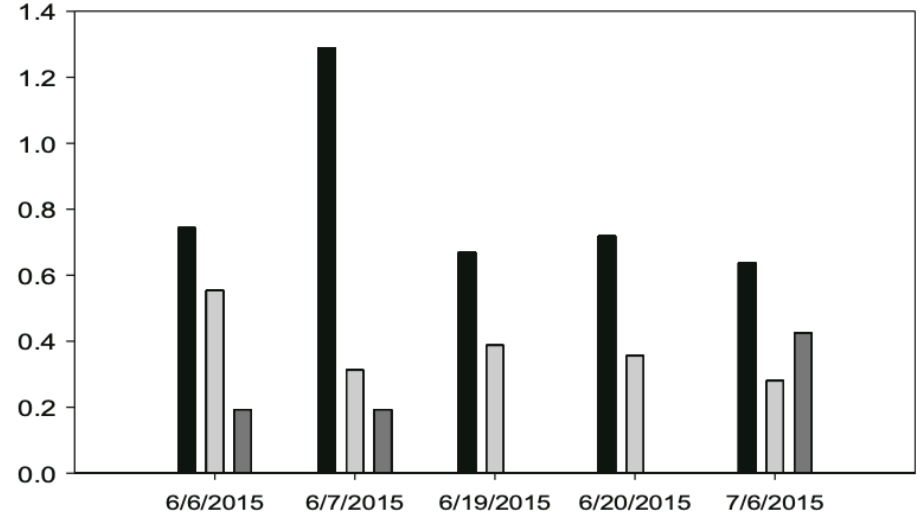
Brandenburg, 2013

Photo Courtesy of Scott Cortus

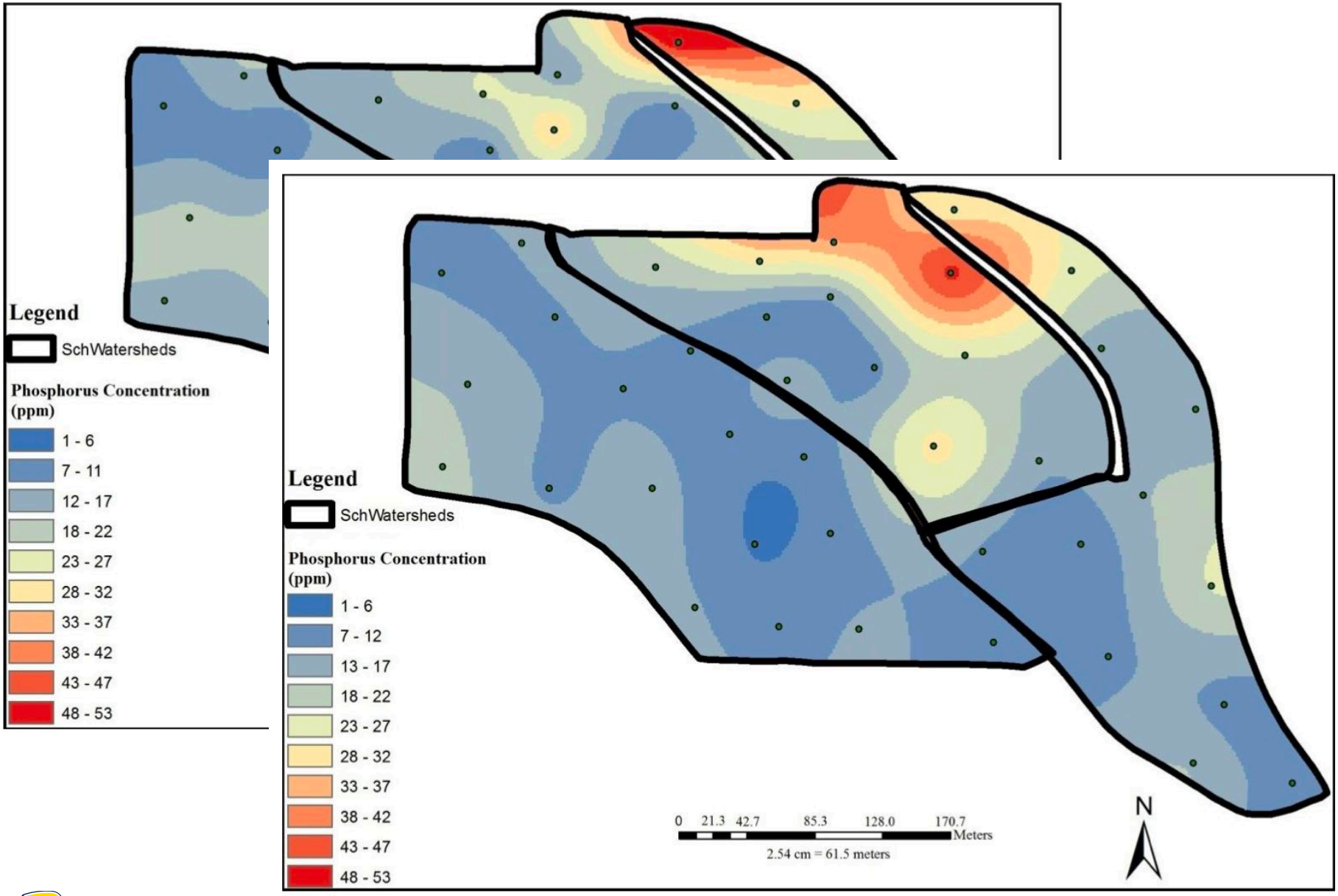








Singh et al., 2017



Olsen P, top 6 inches, Brandenburg 2013

Conclusions

- From the watershed-scale research?

Project Advisory Board

- SD DENR/DANR
- USDA-NRCS
- SD Cattlemen's Association/Cattle Feeders Council
- SD Farm Bureau
- Moody County Conservation District
- East Dakota Water Development District

Financial Support

- EPA 319 via SD DENR/DANR
- SD Water Resources Institute
- East Dakota Water Development District
- SD Cattlemen's Association/Cattle Feeders Council
- SD Beef Industry Council
- SD Corn Growers
- SD Farm Bureau
- SD Pork Producers Board
- SD Agricultural Experiment Station

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- Singh, S. 2016. Response of Soil and Water Quality to Winter Manure Application from Small Agricultural Watersheds in South Dakota. MS Thesis. Department of Plant Science, SDSU, Brookings, SD.
- Siverling, B. 2019. Modeling Runoff from Small Agricultural Watersheds in Eastern South Dakota. MS Thesis. Department of Agricultural and Biosystems Engineering, SDSU, Brookings, SD.

Question and Answer Session

We will draw initial questions and comments from those submitted via the chat box during the presentations.

Today's Speakers

Daniel Andersen – dsa@iastate.edu
Melissa Wilson – wilso984@umn.edu
Todd Trooien - Todd.Trooien@sdstate.edu

Thank you for participating in today's *The Current*!

Visit our website, northcentralwater.org, to access the recording and our webinar archive!

Two upcoming webinars from our soil health and climate teams:

Climate-Smart Agriculture for the North Central US
Wednesday, February 23rd at 2pm CT
https://soilhealthnexus.org/

Hurry Up Please, It's Time: My Takeaway from COP26
Monday, February 28th at 1pm CT
https://northcentralclimate.org