Water Quality: N recommendations models a barrier to adopting BMP's

D.E. Clay, C.G. Carlson, and S.A. Clay

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BMP adoption

- We often view BMP adoption as a function of producers willingness to adopt a practice that we know will improve profitability and reduce agricultural impacts on the environment.
- We often look at the type of learning approach used.
- We try to assess BMP effectiveness with surveys.

Some people have argued that some people are more willingness to accept change than others.

- Peoples willingness to accept change have been categorized into 5 groups,
  - innovators,
  - early adopters,
  - early majority,
  - late majority, and
  - laggards.

Promoting change

- Are these classifications the primary factors influencing behavior change?
- Are low adoption rates a function of mixed messages being sent and that the BMP contain risk.

To change behavior should we evaluate the problem from a farmer perspective?

- Will this increase my profitability
- Will this make me look foolish
- Are the recommendations “good”

BMP adoption

- People’s willingness to change and adopt techniques designed to protect the environment and increase profitability is influenced by their
  - Cultural beliefs,
  - Economics,
  - Willingness to accept risk,
  - Outside pressure, and
  - The ease of integrating new practices into their operation.

Problem: Risk associated with BMP

- The adoption of new techniques contain risk, many crop consultants and farmers are risk intolerant.
  - Are you willing to not apply herbicides or recommend that herbicides or fertilizer not be applied?
- Different messages are being sent,
  - Researchers, teachers, and extension staff do not send the same message.
  - Extension staff in different states have different recommendations.
  - Some recommendations work better than others.

What is the risk associated with N recommendation models in South Dakota, Minnesota, Iowa, and Nebraska.

Data from SD will be used to test these models.

Regional recommendation models

- Regional recommendations are based on a large data set where on average, the recommendations works.
- Often use empirical relationships.
- These models do not attempt to define the local conditions that influence yield and productivity.

Regional N recommendations

- Some form of this regional model

  N rate = constant (yield goal) – credits,

  Has been used to make N recommendations, in South Dakota, Indiana, Michigan, Ohio, Illinois, Missouri, Nebraska, North Dakota, Minnesota, and Pennsylvania.

- Lory and Scharf (2003) evaluated this regional model and reported that that in 298 experiments conducted in Illinois, Minnesota, Missouri, Pennsylvania, and Wisconsin N, the recommended N rates were not correlated (r2 = 0.02) to the economic optimum N rate.
- Bundy (2000) had similar results in Wisconsin.

Based on these findings

- Many states started developing new N regional recommendation models.

South Dakota N Model

- South Dakota did not change their model and is

- N recommendation =

  1.2 x YG – deep nitrate credit – legume credit – manure credit

Western Minnesota Model

- (kg N ha-1) = NG – (residual N credit) – other credits

- NG is a function of soil potential, fertilizer cost, grain value, and risk.

Western Minnesota N recommendations

- Corn cost and fertilizer value

- For example,

  N price ($/lbs) / Crop value ($/bu)

$$\frac{\$0.40/\text{lb}}{\$2.00\ \text{bu}} = 0.20$$

Western Minnesota: Field productivity

Highly	Corn/corn		Corn/bean	
productive	NG Range	MRTN (NG)	NG Range	MRTN (NG)
0.05	130-180	155	100-140	120
0.10	120-165	140	90-125	110
.015	110-150	130	80-115	100
0.20	100-140	120	70-100	85

Western Minnesota N recommendation

N price/crop value (Mod. Productive)	Corn/corn MRTN	Corn/soybean MRTN
0.05	130 vs 155	100
0.10	120 vs 140	90
0.15	110 vs 130	80
0.20	100 vs 120	70

Western Minnesota N recommendation

Soil nitrate-N	Residual N credit
ppm	lbs/ N/acre
0-6 (32 lbN/a)	0
6.1-9.0 (72 lbs N/a)	35
9.1-12 (96 lbs N/a)	65
15.1-18 (144 lbs N/a)	125
>18	155

IOWA-Preseason N recommendations

- The Iowa model does not specifically consider soil productivity levels or pre-season nitrate levels. Credits are given for manure and previous crop.

Price/ratio	Bean/Corn (MRTN)	Corn/Corn (MRTN)
0.05	145	200 (MN 155)
0.10	125	175 (MN 140)
0.15	110	155 (MN130)
0.20	95	140 (MN 120)

Nebraska

- The Nebraska model is,
- N recommended =
  $[35 + (1.2 \times YG) - (0.14 \times YG \times OM) - 8 \times \text{soil nitrate} - \text{other credit}] \times f_A \times f_R$.

f_A is a correction factor for application time,

f_R is a correction factor for the corn: N price ratio

Adjustments for timing (f_A) and price ratio (f_R).

- f_A, split applications, then 0.95
- N applied in the fall, then fa is 1.05.
- N spring applied, then f_A is 1.0

N recommendation model (opposite from the Iowa approach)

Corn/N price	f_R
13 (0.077 price/corn)	1.19
11 (0.091price/corn)	1.13
9 (0.11 price/corn)	1.05
7 (0.14 price/corn)	0.94
6 (0.17 price/corn)	0.87
5 (0.20price/corn)	0.78

Models

- They are doing a good job at integrating costs and value into the decision process.

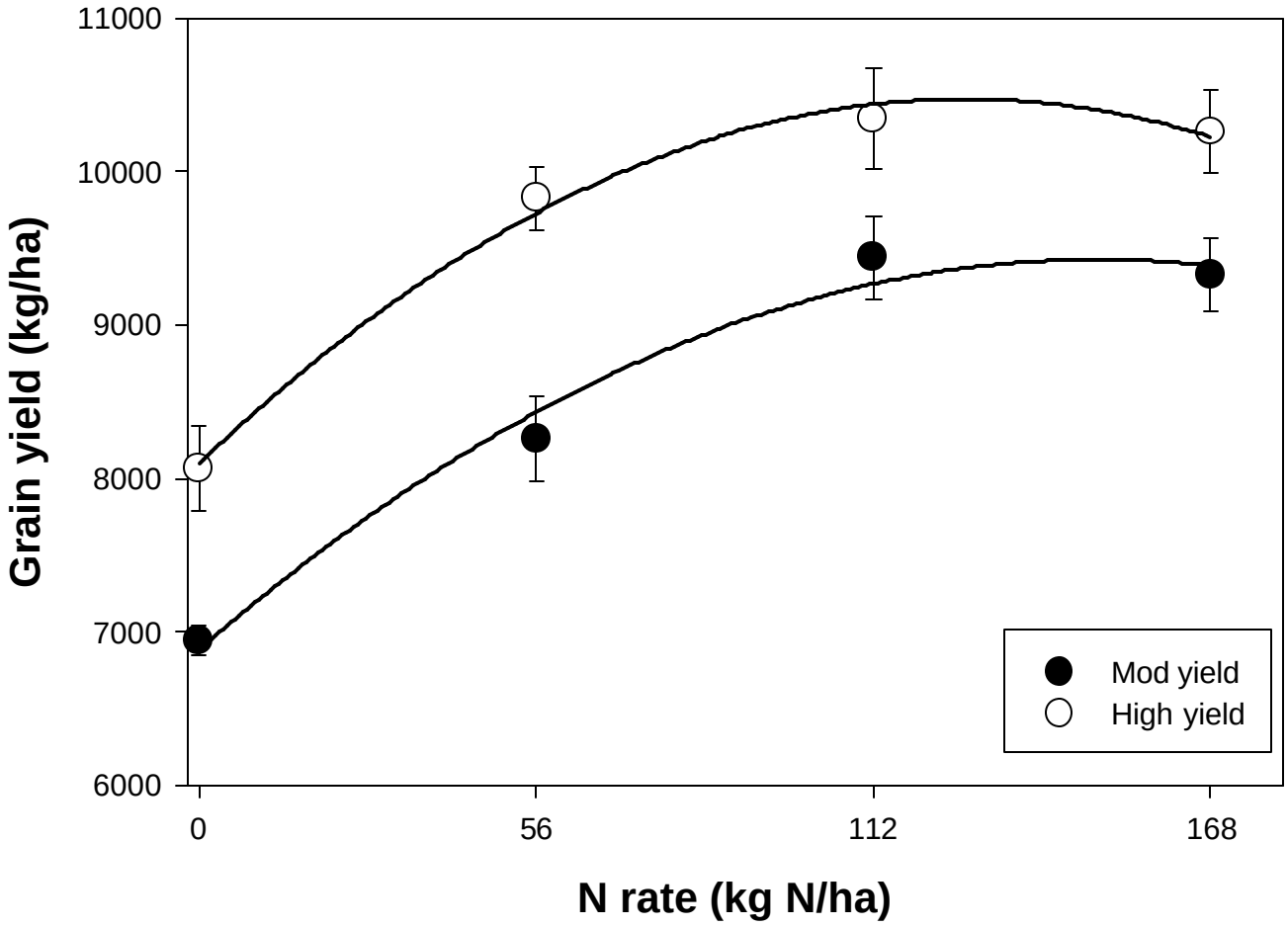
- The Iowa model is based on empirical relationships between yield and fertilizer applications, using this model for site-specific applications would be very difficult.
  - SD could be considered as mechanistic models and we have used it for site-specific applications

- Each states is defining the problem differently.
- Each state is calculating this differently
  - Nebraska uses ppm vs SD which uses lbs/acre
  - Nebraska uses corn value / Ncost while Iowa uses the inverse

Conducted a field experiment between 2002 and 2005.

- N yield response in moderate and high yield environment,
  - Evaluated the influence of soil productivity zone on N responses over a 3 year period.
  - N rate experiment conducted in 2003, 2004, and 2005
  - Yield, water use efficiency, N use efficiency, soil N efficiency were measured

Yield response in moderate and high yield environment



Bottom line

- Management practices that impact the yield goal will impact N use

Yield environment		FUE	Soil N Efficiency (O N)
Moderate (150 bu/acre)		44%	61%
High (180-200 bu/acre)		48%	67%

N recommendation models

Corn Value	Fert. cost	SD RMSE	MN RMSE	Iowa RMSE	NE RMSE
High N/C=	Low .1	2110 (11)	2110 (-30)	3650 (50)	3030 (34)
High N/C=	Mod .2	2150 (20)	1910 (-32)	1930 (32)	1530 (17)
High N/C=	High .45	2890 (40)	1760 (-34)	920 (21)	670 (2.0)

Bias, negative number under fertilize

Summary

- Farmers know that that the states have different recommendation models.

- Sorting through the recommendation models is very difficult.
  - Extensive changes in the models creates mixed messages
  - In many situations they would like to take what is best from each of the models.
- Different models give different recommendations.

Implications toward developing measurable improvement in water quality.

- Mixed messages are being sent.
- To reduce confusion we need an unified message.
- We need to look at the problem from the farmer perspective.