THE MORE-ON PRINCIPLE:
WHY FARMERS USE INPUTS LIKE THEY DO

AAE 320
Paul D. Mitchell
Agricultural and Applied Economics, UW-Madison
Common Paradox in Farm Management

- See many claims that farmers “over use” some inputs that cause environmental pollution: fertilizer, pesticides
- Why would farmers waste money on inputs that they do not need?
- Information deficit problem: Need more education and extension
- Risk: They are using inputs for risk management, so insurance
- Trust: Do not trust the test, technology, science: Demonstrations
- Use subsidies to pay them or Regulations to force them
- Social science response: We do not understand farmer rationality
Summary of the Main Point

1) Production function becomes *inelastic* (flat) at or near optimal levels for many inputs, so small profit changes occur over a wide range of input levels
   - *Wide range of input levels will seem consistent with maximizing profit*
2) Impact of inputs on yield and profit is hard to clearly identify with all the *variability* from other factors
   - *Even science has a hard time identifying what’s economically optimal*
3) Underuse of key inputs is obvious, but *overuse is invisible*, and inputs are relatively *low cost*
   - A common human response in situations like these is to put a little more on, hence the name “The More-On Principle”
   - This is part of the farmer rationale driving “over use” of some inputs
Farming a Flat Function

- For many crop production processes, yield becomes relatively unresponsive to inputs when they are used at near optimal levels.
Profit becomes Inelastic to Input Levels

- As a result, profit also has a “flat” response to the input with a long slow decline for the relatively low-cost input
One Site-Year from Iowa (Mitchell 2004)

- Yield response flattens out
- See the yield variability
Average Corn Yield by N Rate (Mitchell 2004)

Yield response flattens out
Current WI N Recommendations

- Effect of flat yield response curve on optimal N rate
- Wide range of N rates within $1/ac of optimum
Effect of Flat Yield Response Curve on Optimal N Rate

### University of Wisconsin Nitrogen Guidelines for Corn

<table>
<thead>
<tr>
<th>Soil</th>
<th>Previous Crop</th>
<th>N:Corn Price Ratio (see table on other side)</th>
<th>lbs N/acre (total to apply)²</th>
</tr>
</thead>
</table>
| high/very high yield potential soils | Corn, Forage legumes, Legume vegetables, Green manures⁶ | **0.05** | 170¹  
155---185⁴  
140  
125---160 |
|                           | Soybean, Small grains⁶                  | **0.10** | 150  
135---160  
120  
105---135 |
| medium/low yield potential soils | Corn, Forage legumes, Legume vegetables, Green manures⁶ | **0.15** | 130  
120---145  
105  
95---115 |
|                           | Soybean, Small grains⁶                  | **0.20** | 115  
105---125  
95  
80---105 |
| sands/loamy sands         | Irrigated—All crops⁶                    |            | 125  
110---140  
110  
90---125 |
|                           | Non-irrigated—All crops⁶                |            | 110  
100---115  
85  
70---95 |
|                           |                                        |            | 100  
95---110  
70  
60---80 |
|                           |                                        |            | 95  
85---100  
60  
50---70 |

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Corn following Corn: 120-145 lbs/ac, $54 to $65.25/ac in costs, **$11.25/ac range**
Corn following Soybeans: 95-115 lbs/ac, $42.75 to $51.75/ac in costs, **$9/ac range**

[^2]: Total N rate applies based on N:corn price ratio and yield potential. For example, if N:corn price ratio is 0.15 and total N rate is 100 lbs N/acre, then 150 lbs N/acre of total N would be applied.

[^1]: Yield potential is determined based on site-specific conditions and management practices.

[^6]: Additional considerations include soil test nitrogen, crop yield potential, and environmental conditions.

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http://corn.agronomy.wisc.edu/Management/pdfs/L025_N_card_extended.pdf
What's wrong with my plant?

1. Healthy leaves shine with a rich dark green color when adequately fed.
2. Phosphate shortage marks leaves with reddish-purple, particularly on young plants.
3. Potash deficiency appears as a firing or drying along the tips and edges of lowest leaves.
4. Nitrogen hunger sign is yellowing that starts at the tip and moves along middle of leaf.
5. Magnesium deficiency causes whitish strips along the veins and often a purplish color on the underside of the lower leaves.
6. Drought causes the corn to have a grayish-green color and the leaves roll up nearly to the size of a pencil.
7. Disease, helminthosporium blight, starts in small spots, gradually spreads across leaf.
8. Chemicals may sometimes burn tips, edges of leaves and at other contacts. Tissue dies, leaf becomes whitecap.

Source: https://crops.extension.iastate.edu/files/article/nutrientdeficiency.pdf
What does corn look like if it has Too much Nitrogen?
Too much Phosphorus?      Too much Pesticide?
Corn Returns to Seeding Density
(Lauer and Stanger 2006)

- Effect of flat yield response curve on optimal seeding rate
- Wide range of seeding rates within $1/ac of optimum

Source: http://corn.agronomy.wisc.edu/AA/pdfs/A044.pdf
Soybean Returns for Seeding Density and Seed Treatments (Gaspar et al. 2014)

Capture (bifenthrin) on Processing Sweet Corn (mean with 95% error bars)

- Yield response flattens out
- See the yield variability
Capture (bifenthrin) on Fresh Market Sweet Corn (mean with 95% error bars)

- Yield response flattens out
- See the yield variability
- How many sprays would you use?
Yield Response to Applied N
(Fresh Russets in 2018 at Hancock)

- Yield response flattens out
- See the yield variability

Data Courtesy of Yi Wang, UW-Horticulture
Summary: Why do farmers use inputs like they do?

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