

Nitrogen Fertilizer Use Efficiency and Fertilizer Economics

Cabin Fever

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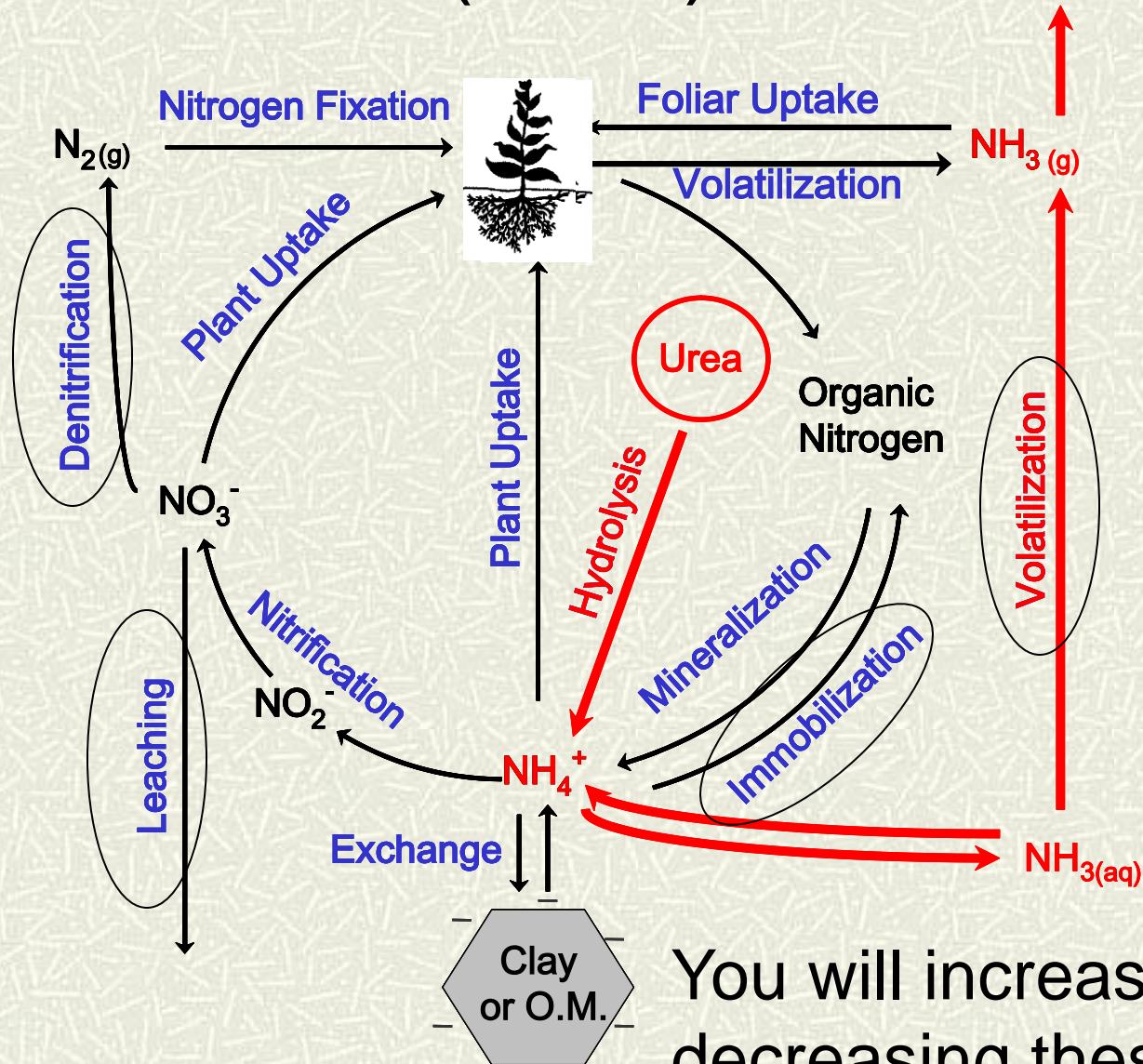
AGRICULTURE

MAKING A DIFFERENCE IN MONTANA COMMUNITIES

Goals today

- Discuss processes that happen to nitrogen (N) fertilizer once applied
- Discuss ways to increase N fertilizer use efficiency
- Show our economic tool that determines optimal N rate for small grains

Increasing Nitrogen Use Efficiency (NUE)



You will increase NUE by decreasing these losses

How do I decrease N losses?

- Subsurface apply when possible
 - Prevents volatilization
 - Increases root growth and uptake
 - Decreases possible erosion losses
- Time application as close to peak N uptake as possible

Increasing N Fertilizer Use Efficiency

- Enhanced Efficiency Fertilizers

Two major types:

slow release (ex: ESN, NSN)

urease inhibitors (ex: Agrotain)

- Should you consider using them?

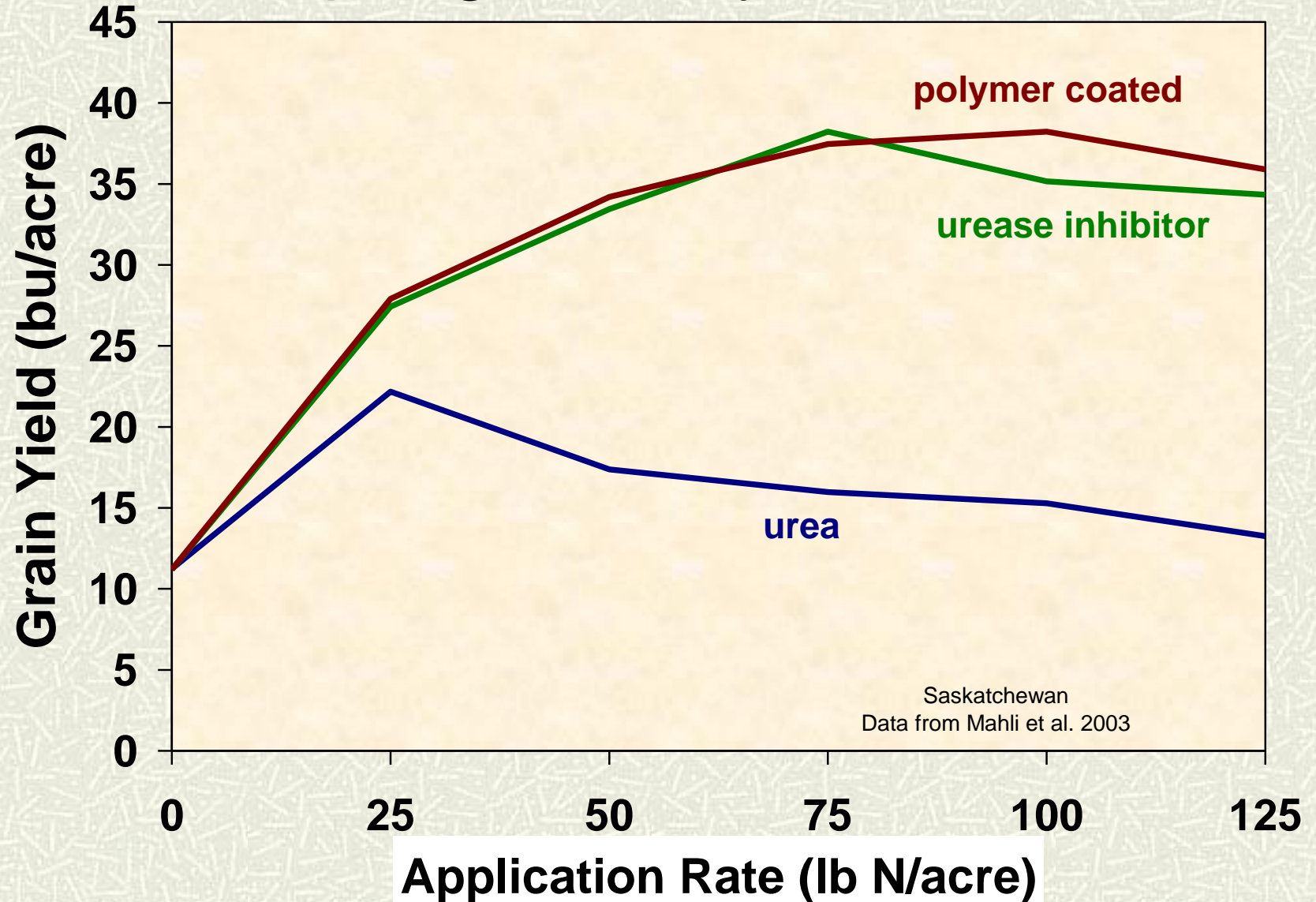
Yes: on warm season, irrigated crops

Maybe: on cool season, dryland crops

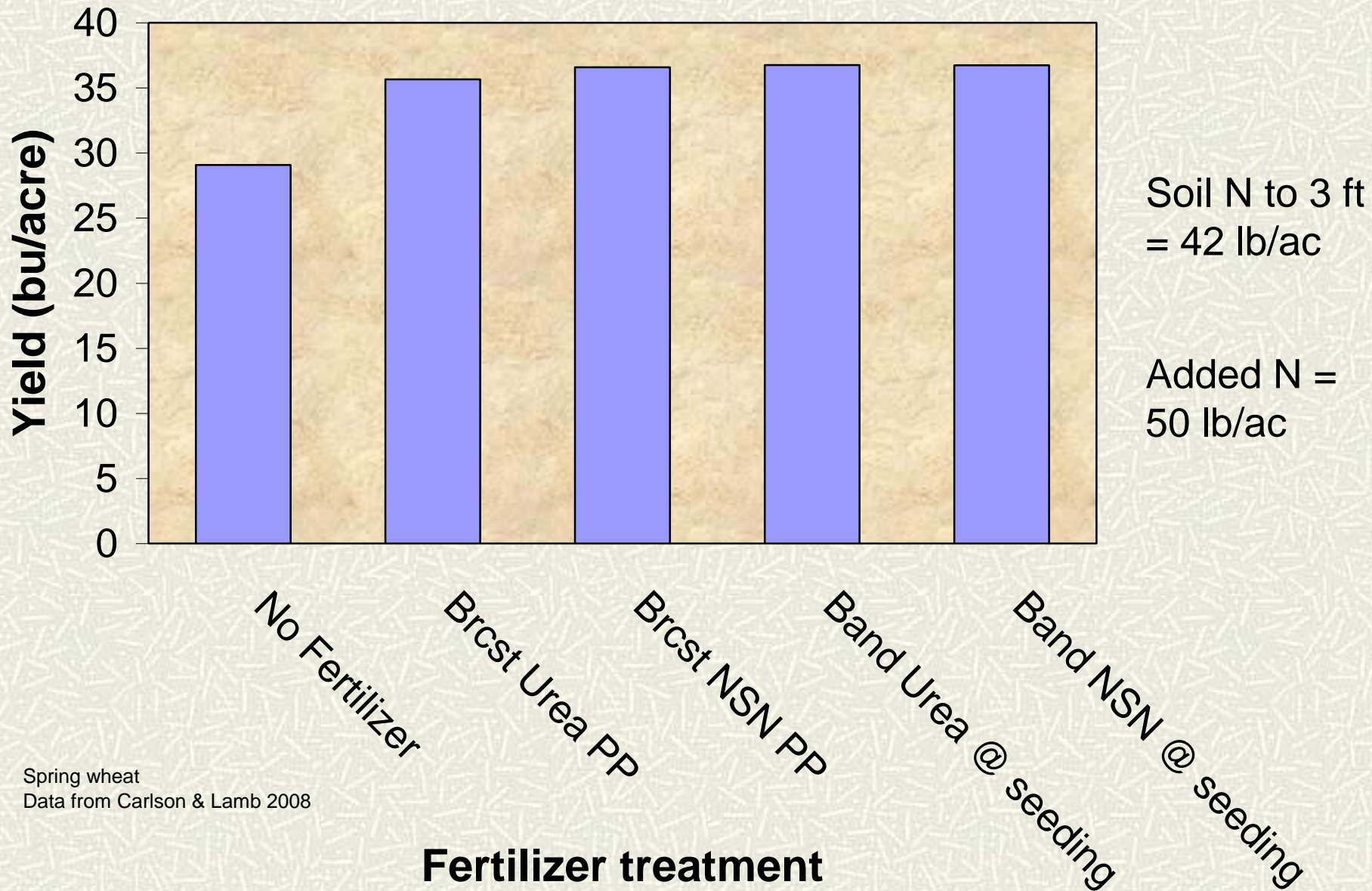
Downside-N release often occurs too late to match N uptake

Upside-can apply ~2 – 4x as much slow release product as urea directly with the seed.

Effect of N source applied with the seed on spring wheat yield



Effect of an enhanced efficiency fertilizer (NSN) on spring wheat grain yield at Havre



Increasing N Fertilizer Use Efficiency

- Soil Test

When??

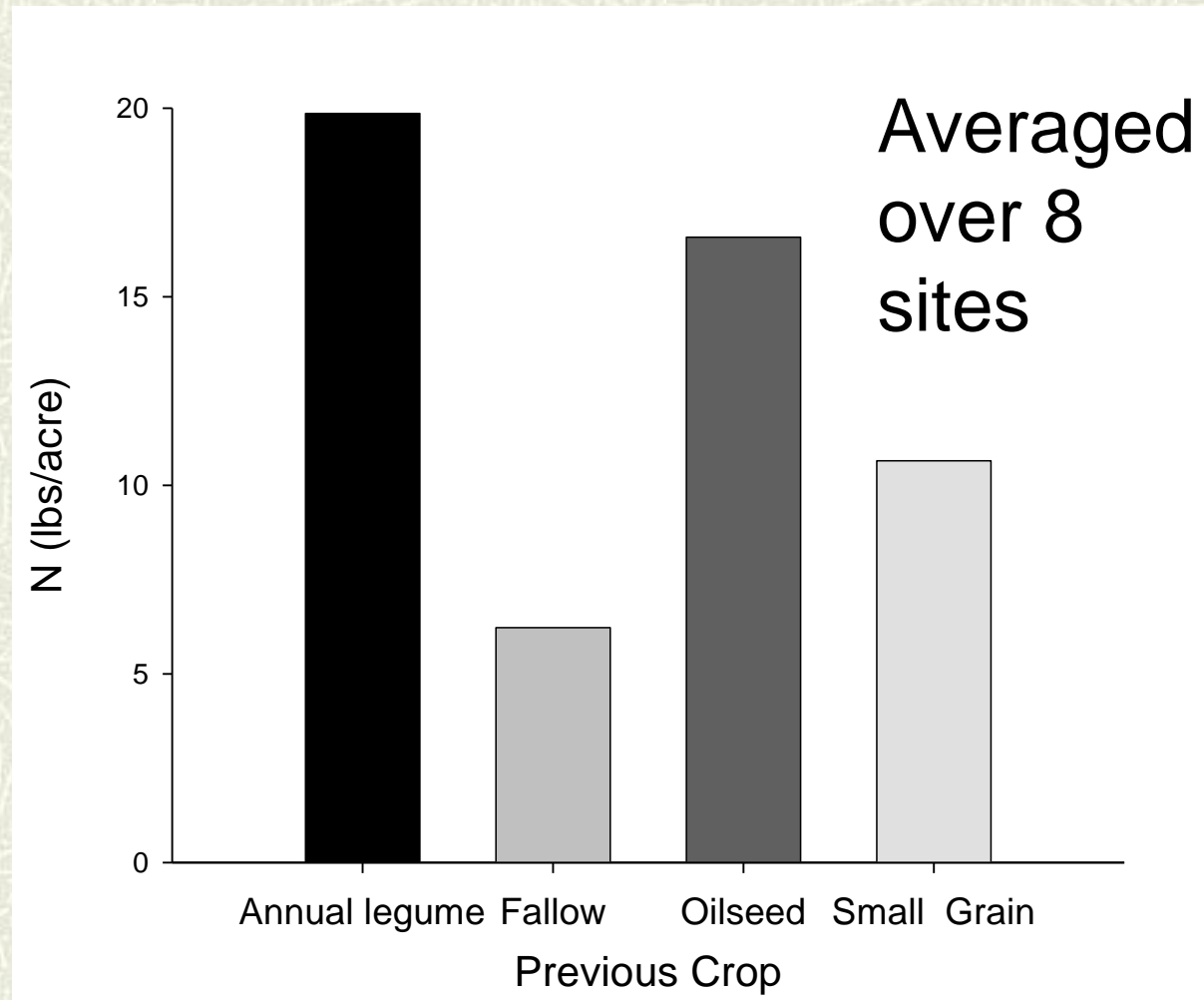
Spring is best

Why??

~ 10 to 30 lb nitrate-N/acre more in spring than late summer depending on previous crop and location (Miller unpub. data)

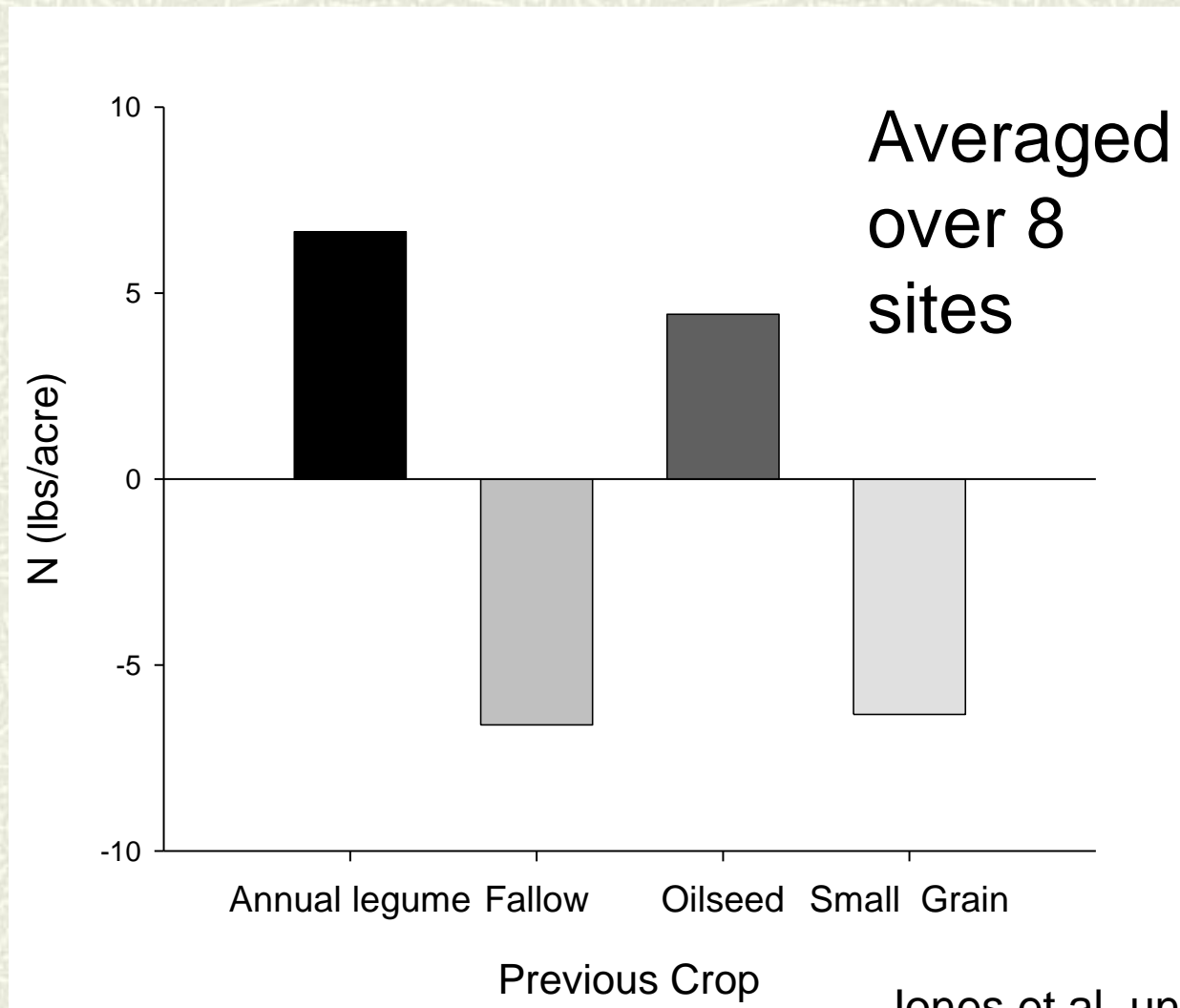
Result: Fertilizing more than needed (\$\$)

April 2008 – August 2007 Nitrate-N Differences in Montana



Jones et al. unpublished data

April 2008 – Nov 2007 Nitrate-N Differences



Jones et al. unpublished data

Increasing Net Profit from N Fertilizer

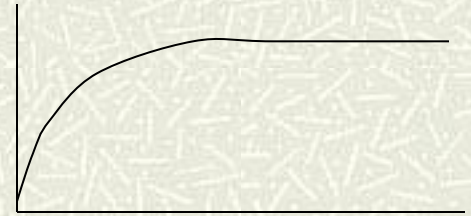
- Use an economic N model developed by Griffith and Jones

Economic Model Development

- First, need yield and protein models
- Models based on N responses from plot studies, mostly on fallow.
- Spring Wheat: 25 site-years all in Golden Triangle, 1993-2006 ([my focus today](#))
- Winter Wheat: 70 site-years from wide range of Montana. 1970-2006
- Barley: ~30 site-years from Golden Triangle and Moccasin. 1981-2006

Model Development

- “Quadratic Plateau” models appear to fit data the best



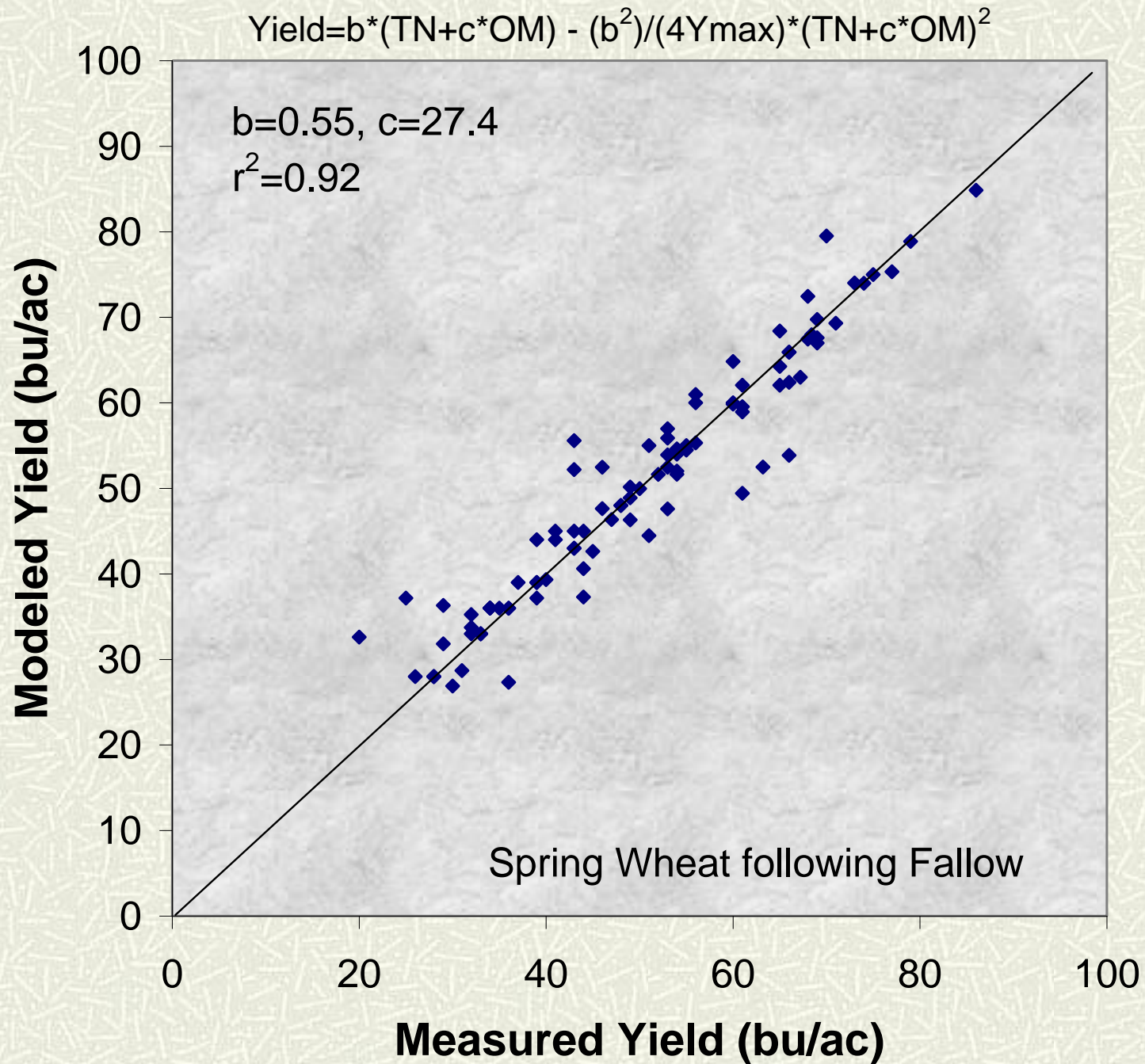
- Yield (Y) = $b \cdot \text{TUN} - c \cdot \text{TUN}^2$

TUN = Total Useable Nitrogen

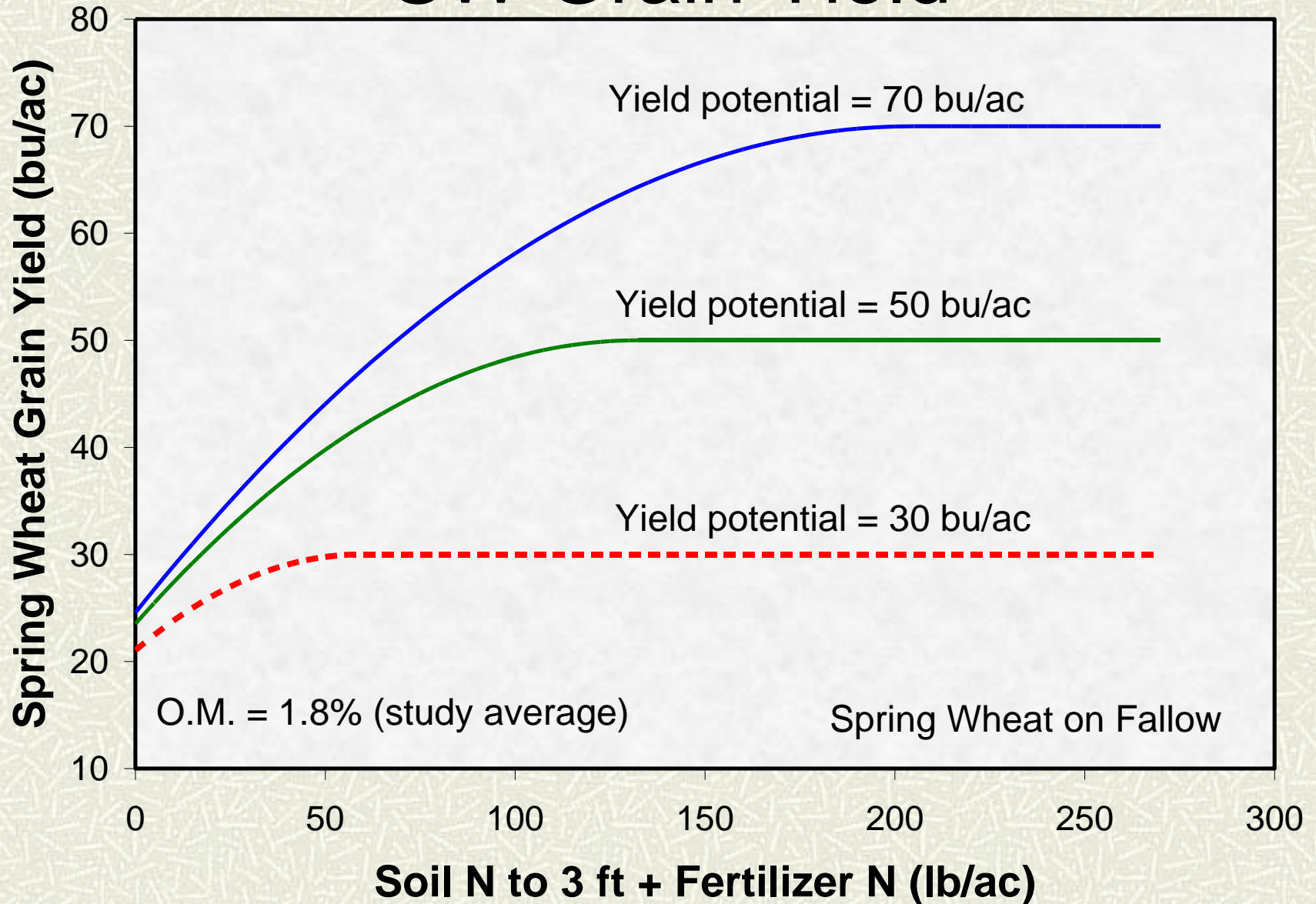
= Soil nitrate + Fertilizer N + N from O.M.

$$c = b^2/4Y_{\text{max}}$$

- $Y = \text{Yield Goal when TUN} > \text{optimum N}$



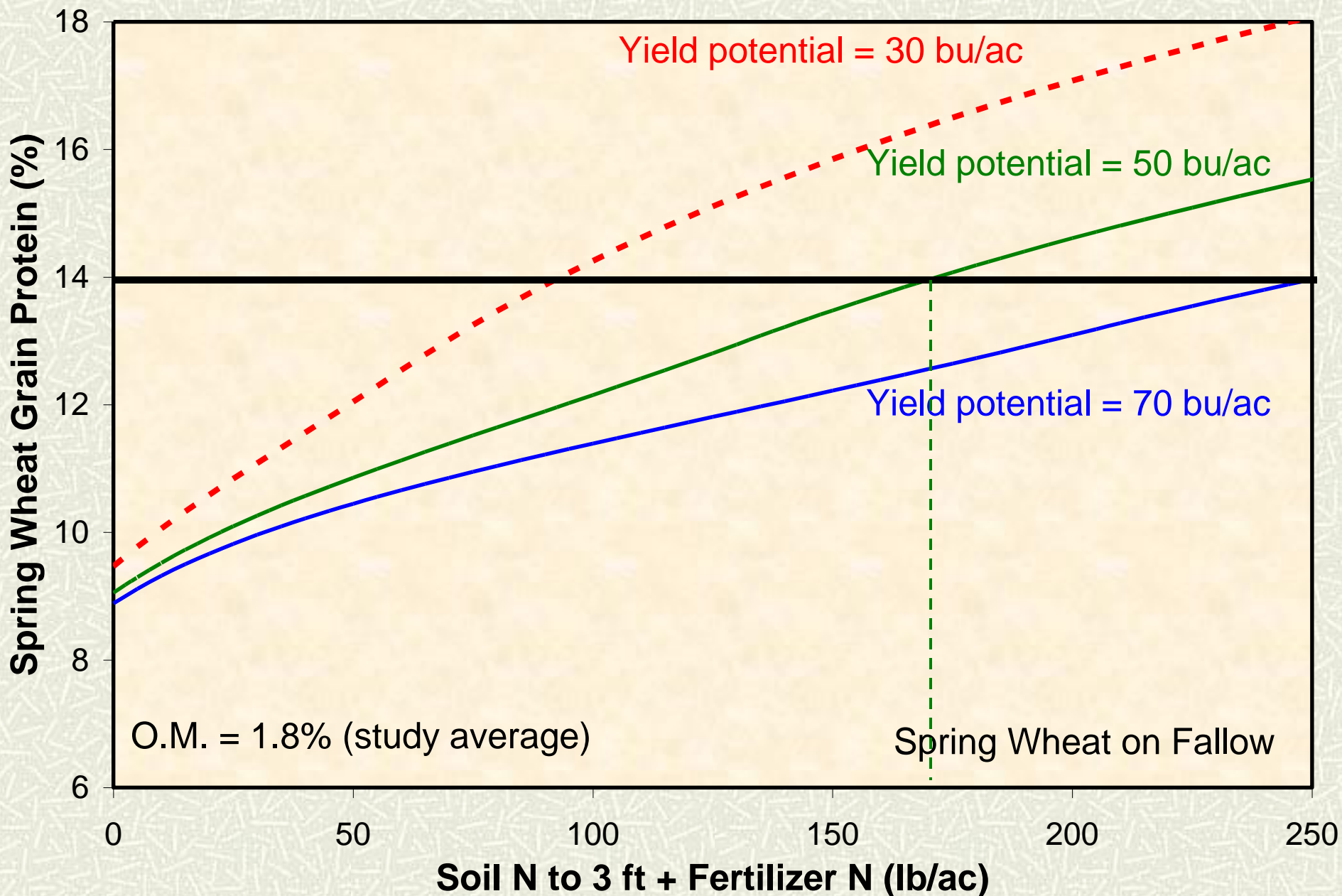
Effect of N and Yield Potential on SW Grain Yield



How much N was needed to obtain maximum yield?

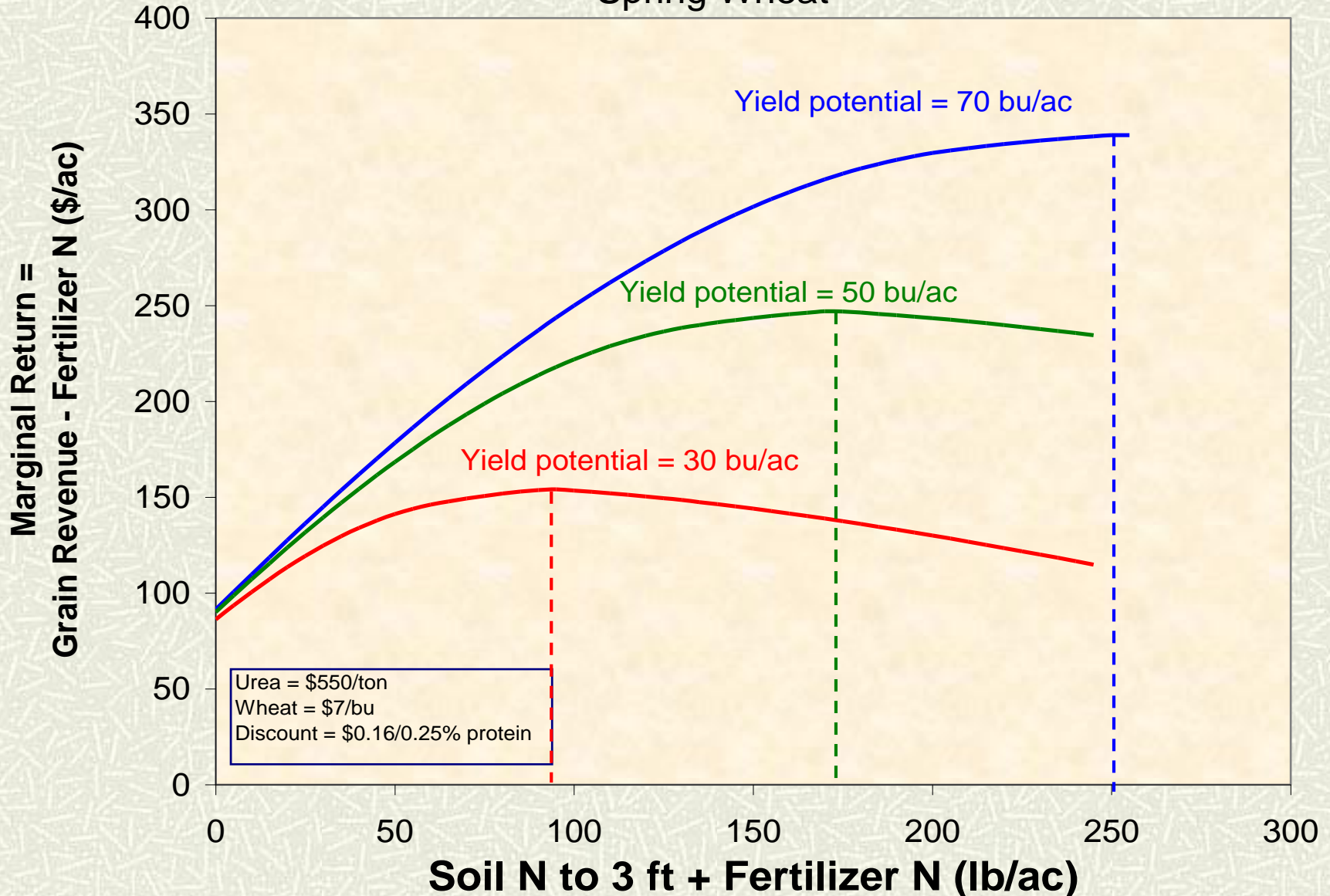
- 30 bu/ac: ~2.0 lb N/bu
- 70 bu/ac: ~2.8 lb N/bu
- MSU guidelines? **3.3 lb N/bu**
- **Why different?**
- **Where did 3.3 come from?**

Effect of N and Yield Potential on Grain Protein

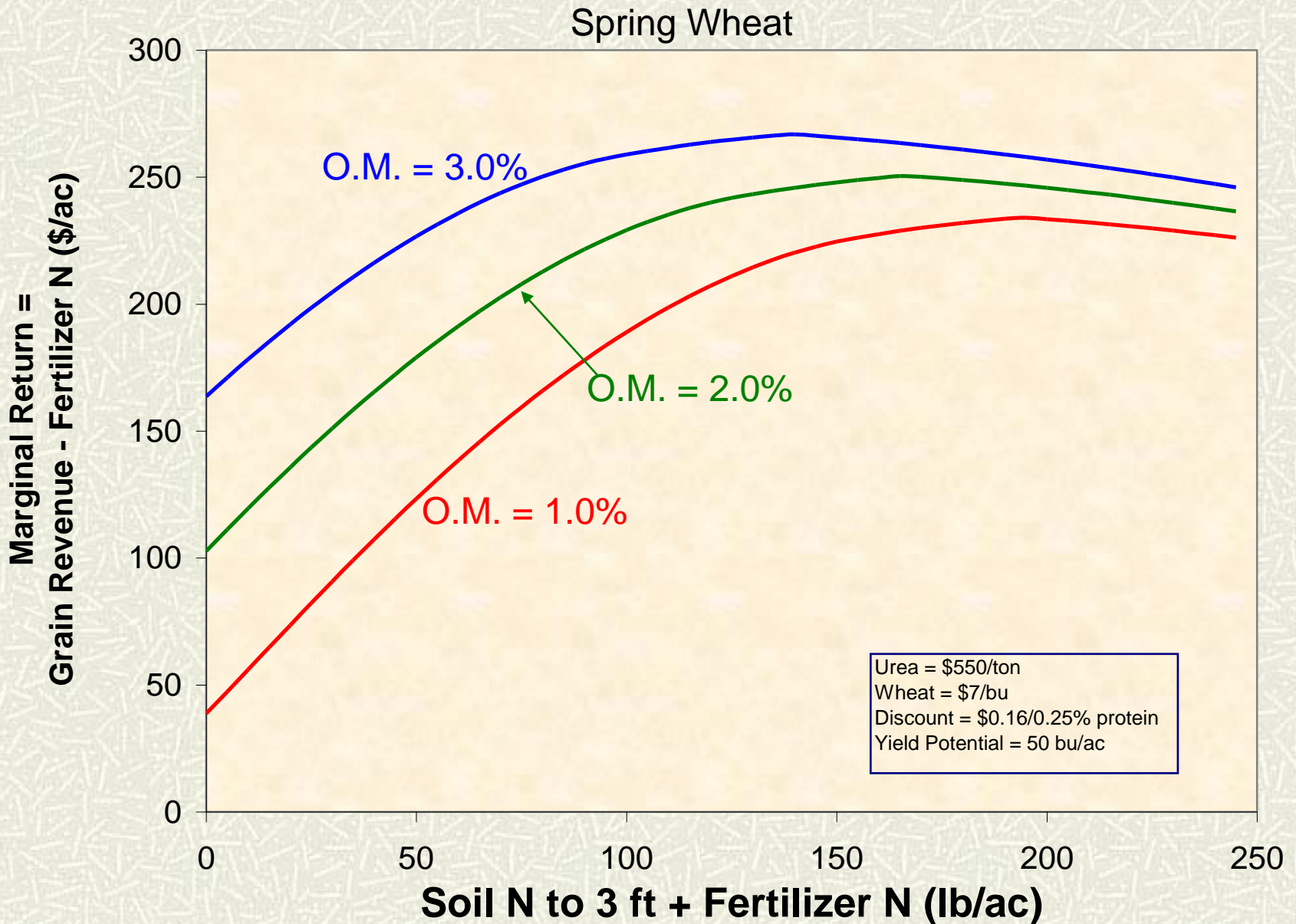


Effect of N and Yield on Marginal Return

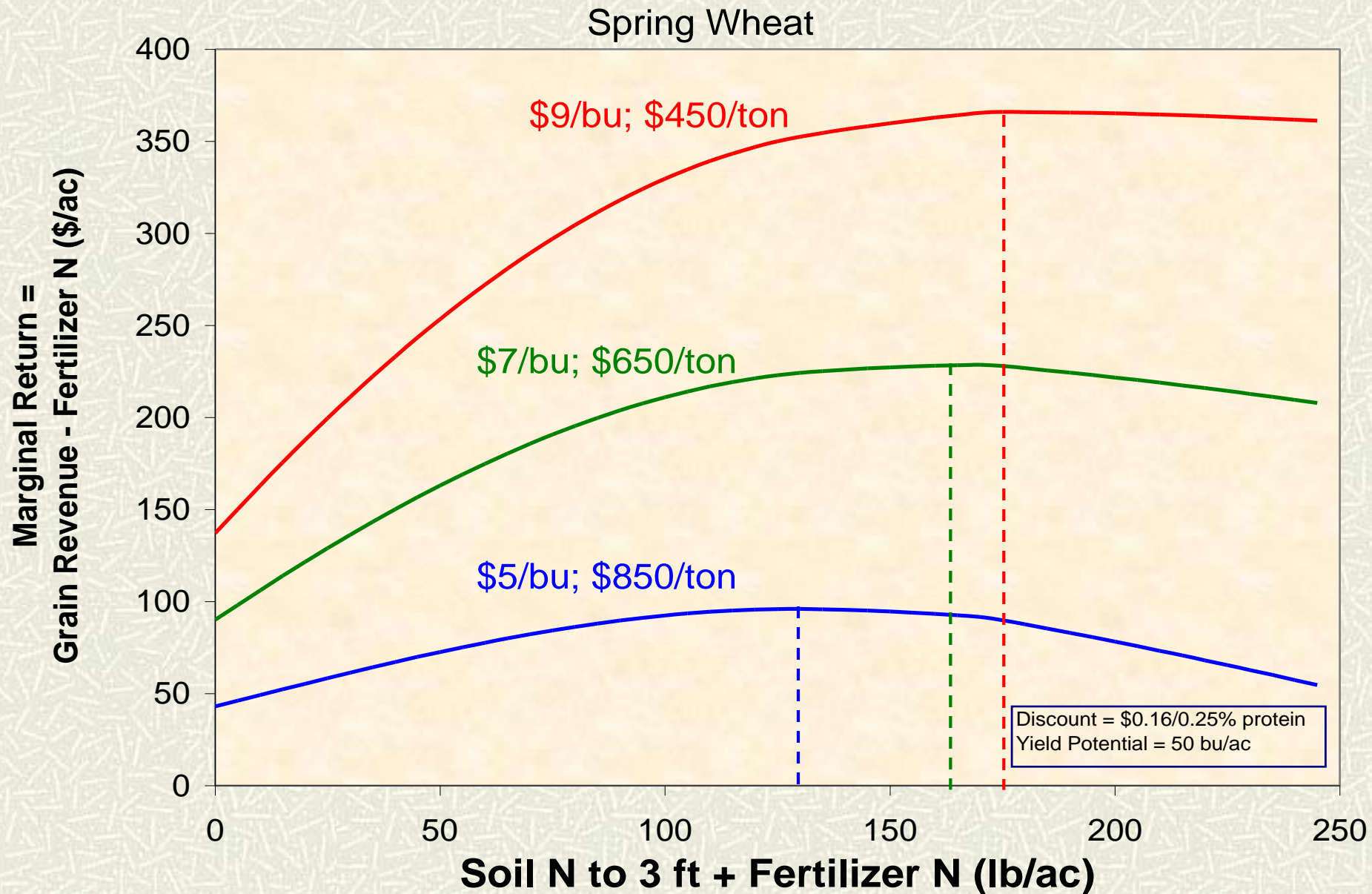
Spring Wheat



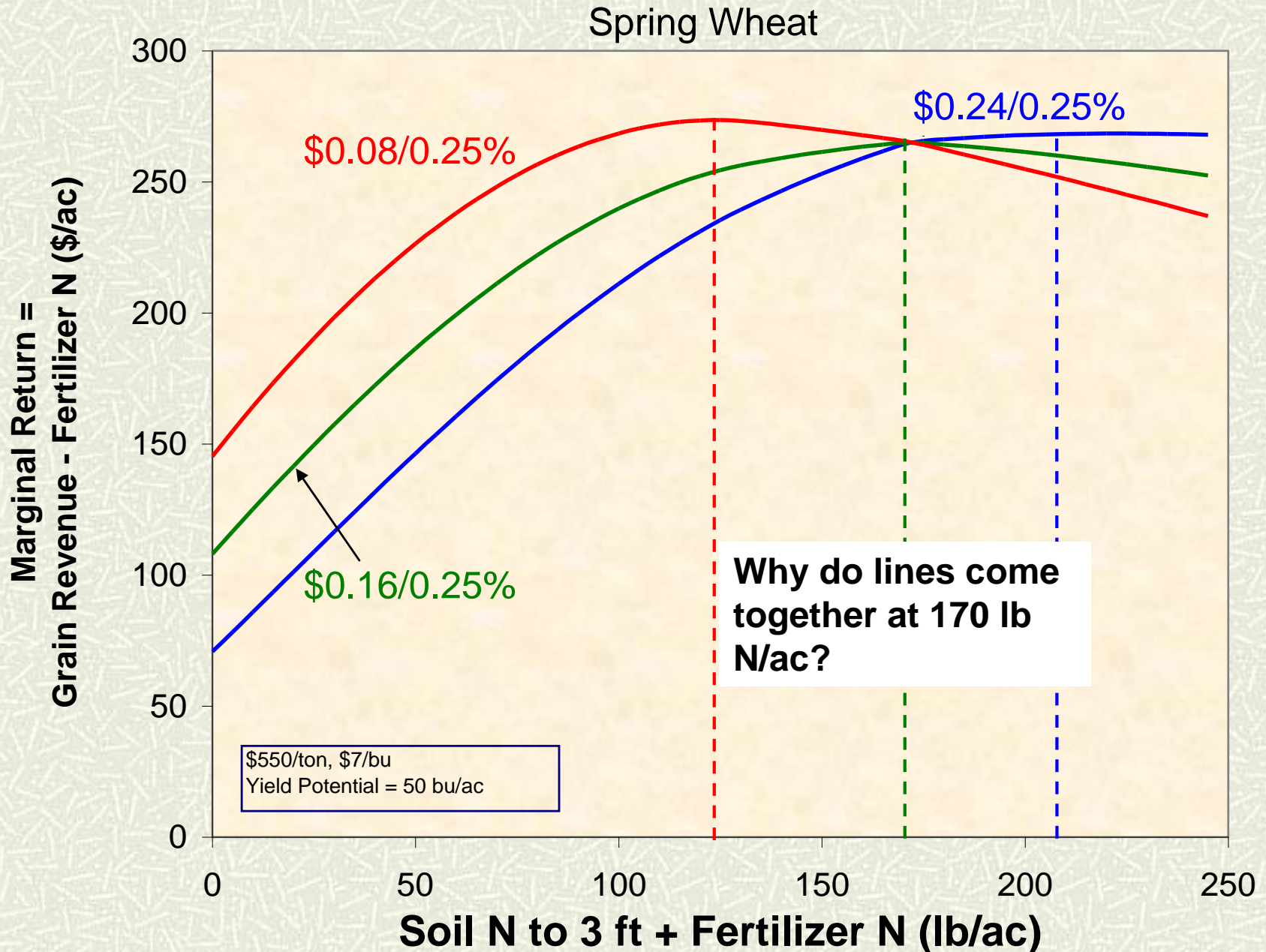
Effect of Organic Matter on Optimum N Rate



Effect of Grain Price and Urea Cost on Marginal Return



Effect of N and protein premium on marginal return



Total Available N for Maximum Return on SW following Fallow (lb N/bu)

Protein Discount (¢/0.25%)	\$450/ton	\$650/ton	\$850/ton
8	2.6	2.4	2.2
16	3.5	3.4	2.6
24	5.6	3.6	3.4

Based on \$7/bu, 50 bu/ac, 2% O.M.

Questions so far?

Winter wheat and barley models have also been developed

- For TODAY's prices, discounts, and costs, and O.M. of 2%.

Economic optimum N rates:

Winter wheat ~ 2.5 to 2.7 lb N/bu for yields of 30 to 70 bu/ac.

Malt Barley ~ 0.9 to 1.1 lb N/bu for yields of 40 to 80 bu/ac.

- For 2008 RANGE of prices, discounts, and costs, and O.M. of 1.5 – 2.5%.

Economic optimum N rates:

Winter wheat ~ 2.0 to 3.0 lb N/bu for yields of 30 to 70 bu/ac.

Malt Barley ~ 0.6 to 1.2 lb N/bu for yields of 40 to 80 bu/ac.

Conclusions

- Nitrogen Use Efficiency can be increased by soil testing late Fall to early Spring.
- Despite recent high N prices, N fertilizer can still increase bottom line by up to about \$200/acre.
- Economically optimum N rates depend on fertilizer N cost, grain price, protein premium, organic matter, and yield goal.
- Rates of N fertilizer should be backed off from the recommended rate (i.e. 3.3 lb N/bu SW) when fertilizer price is high and protein discount is low.
- Fertilizer N rates should be close to recommended rate when commodity and protein discounts are high, and N price is 'low'.

For more information on soil testing and nutrient cycling: <http://landresources.montana.edu/soilfertility>

To access the models click on [Fertilizer Economics](#).

QUESTIONS?