MANAGEMENT EFFECTS ON NUTRIENT AVAILABILITY FROM DAIRY HEIFER MANURE

John Peters, Patrick Hoffman and Michael Bertram
University of Wisconsin-Madison

Background

- Wisconsin dairy producers rear over one million dairy replacement heifers at a cost of about $825 million annually.

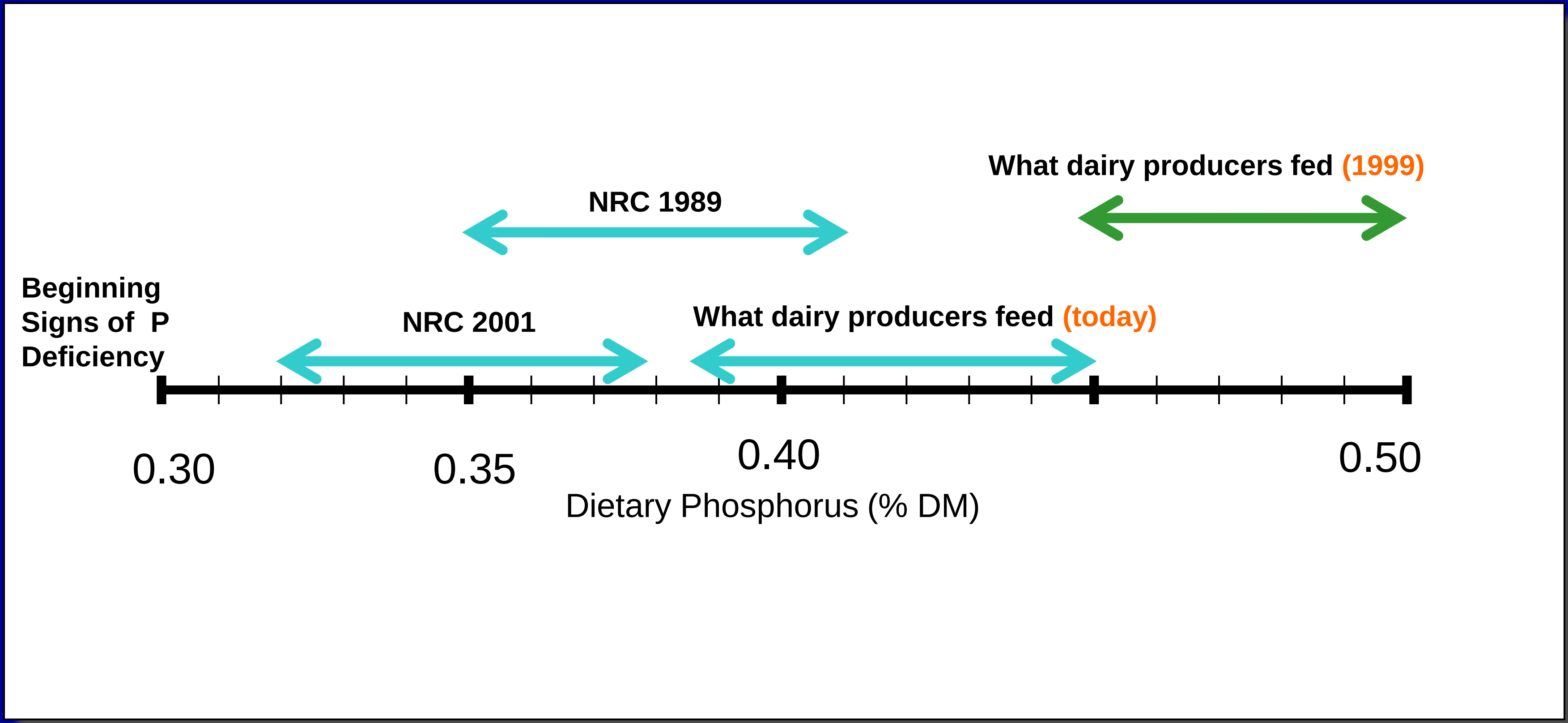
- These heifers consume 18 million tons of feed and produce 61 million tons of manure

- Producers strive to reduce cost and environmental impact without compromising future milk production

- Limit feeding has been studied in an attempt to reduce feed cost and manure excretion

- Reducing or eliminating supplemental P in diets has also been studied

How much P is being fed?



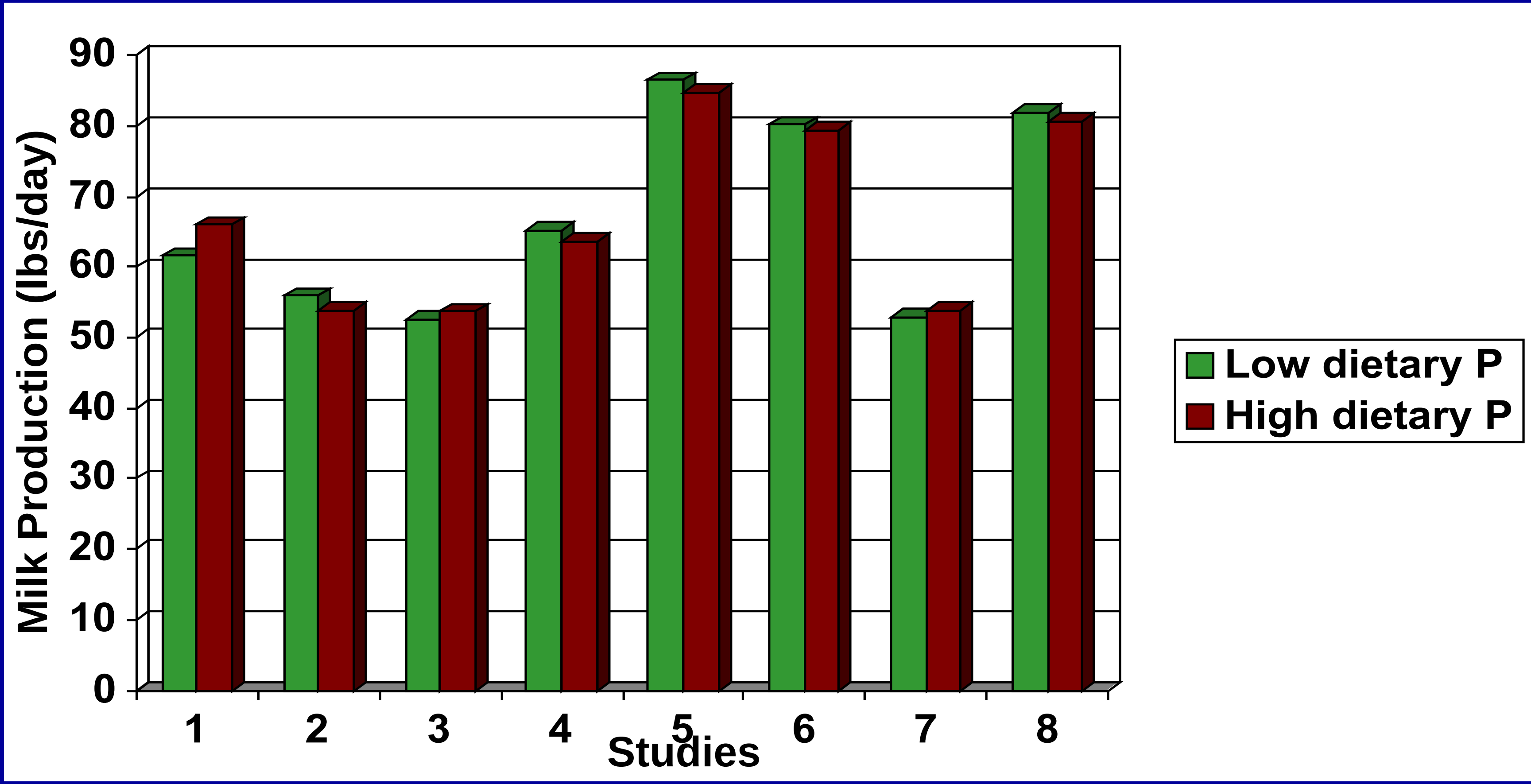
Why is P overfed?

- ‘Myth’ that increasing P improves reproductive performance
- Little research on the absolute minimum P content required to support moderate to high levels of milk production

Debunking the myth:

Milk production is not harmed by lower P diets

Summary of 8 studies



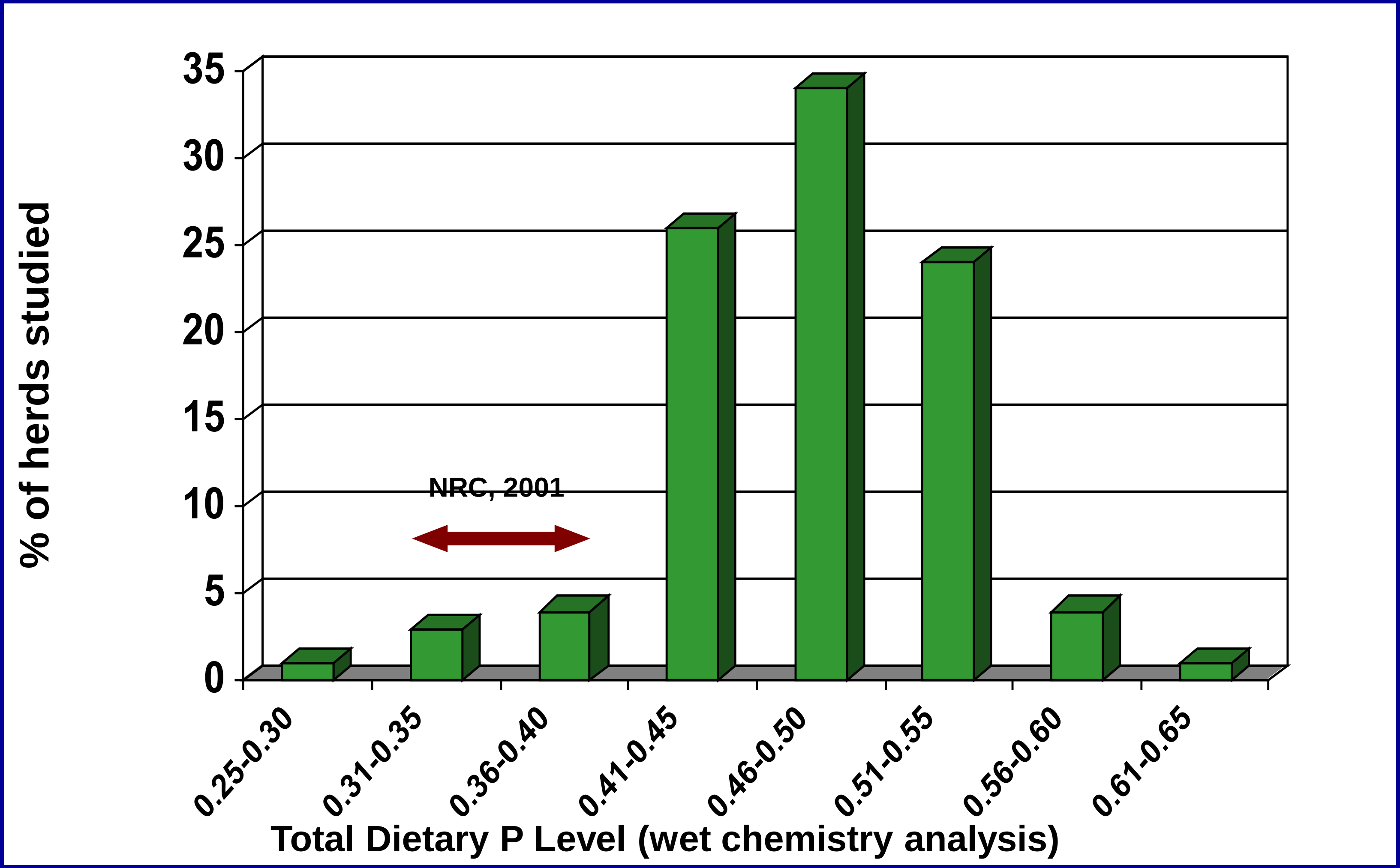
Assessment Tool:

TMR

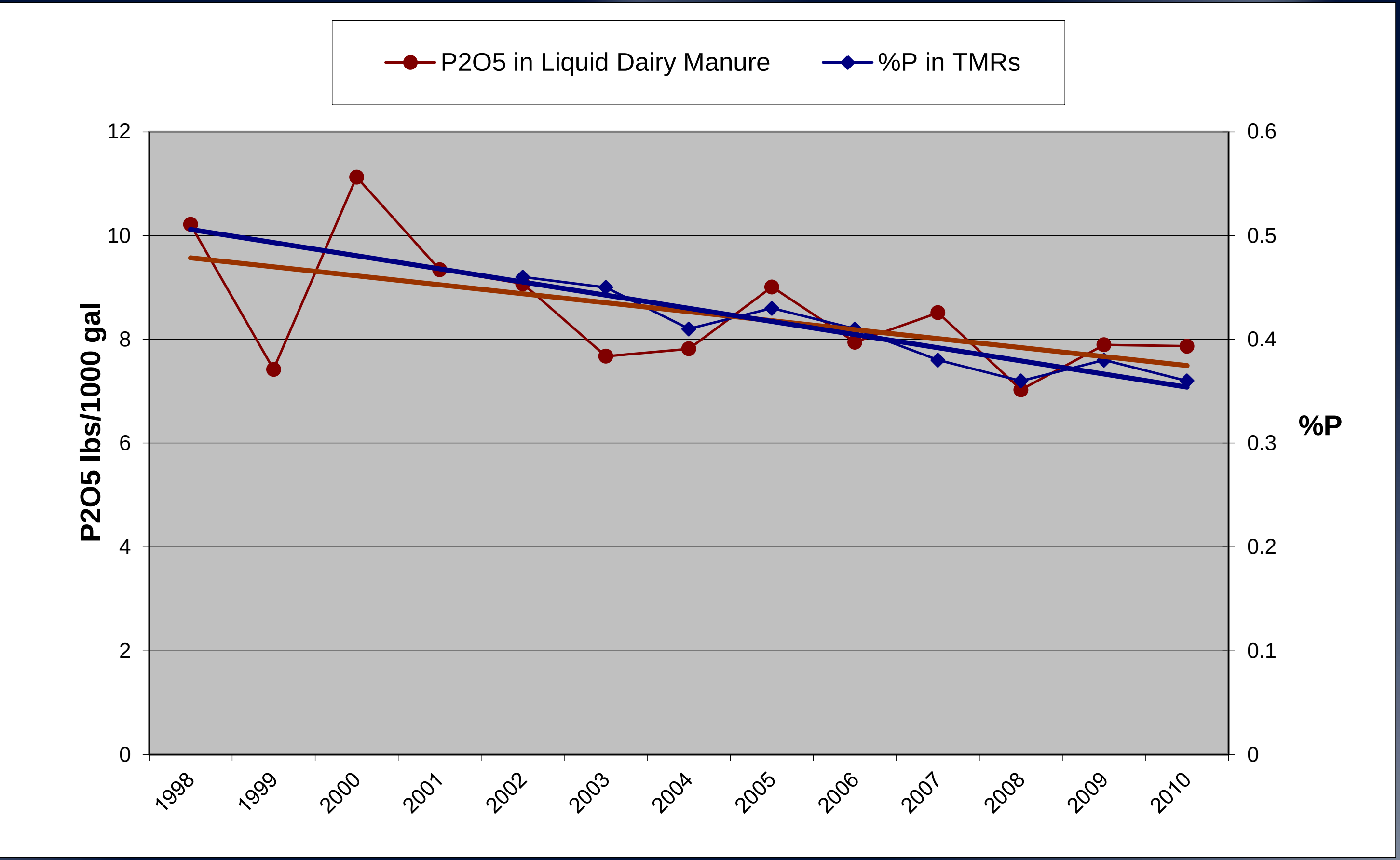
Evaluation

Dietary P data from 89 high-producing dairy herds

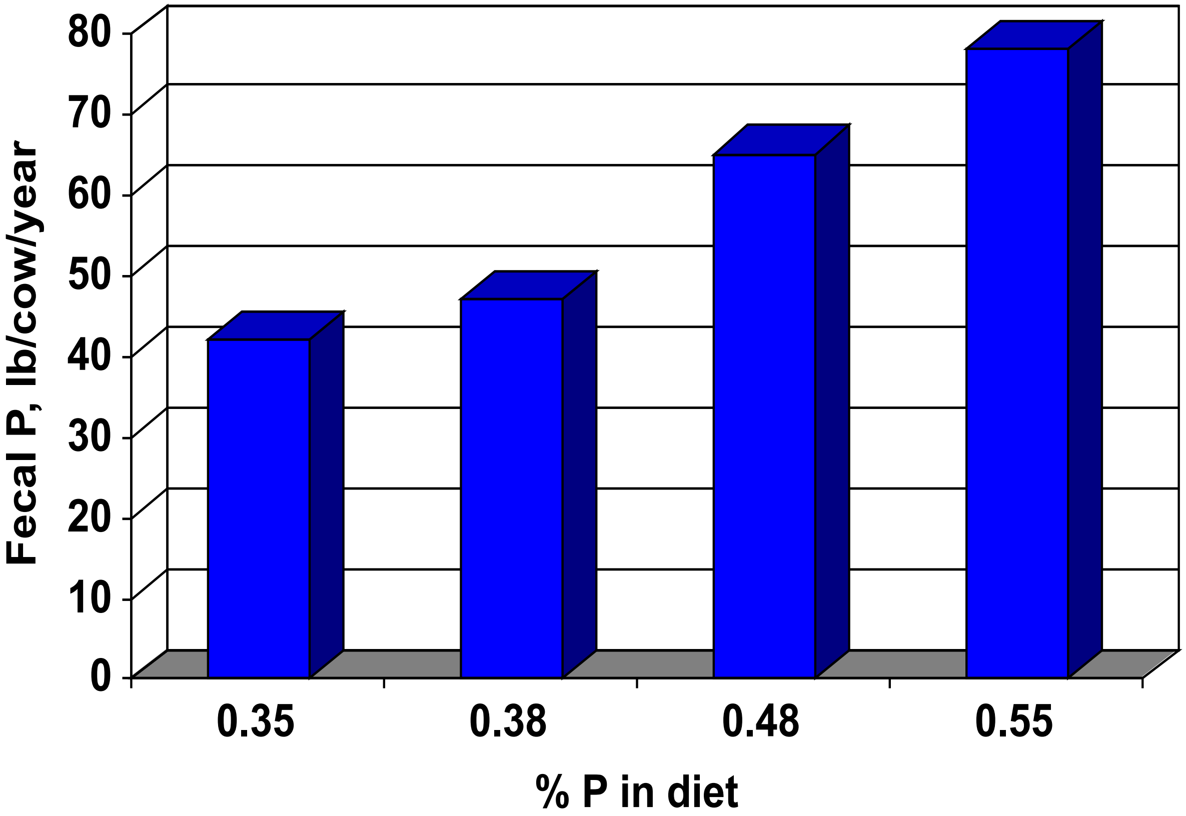
UW Soil & Forage Analysis Lab – Marshfield, WI-2002



Long term trends in P levels in liquid dairy manure vs. TMRs

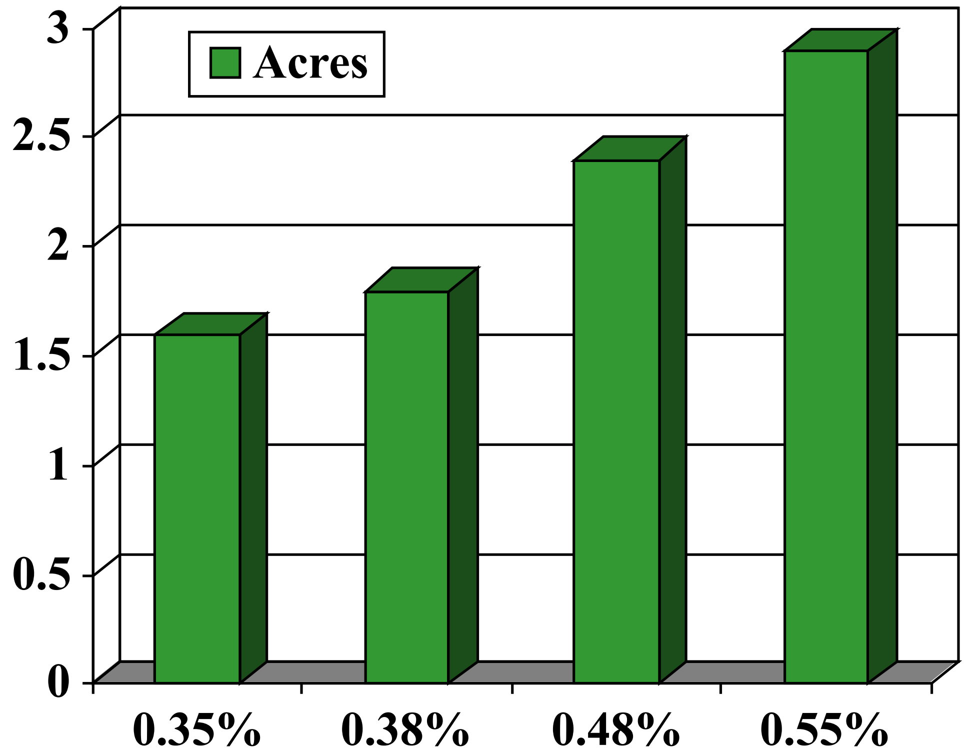


Effect of P intake on P in manure



Increasing P content from 0.35% to 0.55% of diet dry matter increases P output from 42 to 78 lbs/cow/year!

Land required for recycling fecal P from one cow fed various dietary P levels



Dietary P level

†Alfalfa, corn , soybean rotation with 27 lb P/a removal

Objectives of this NC-1042 regional project

- **Evaluate the effect of reduced P in diets fed to dairy heifers**

- **Evaluate the effect of limit feeding on the short and long term performance of dairy heifers as well as on manure output**

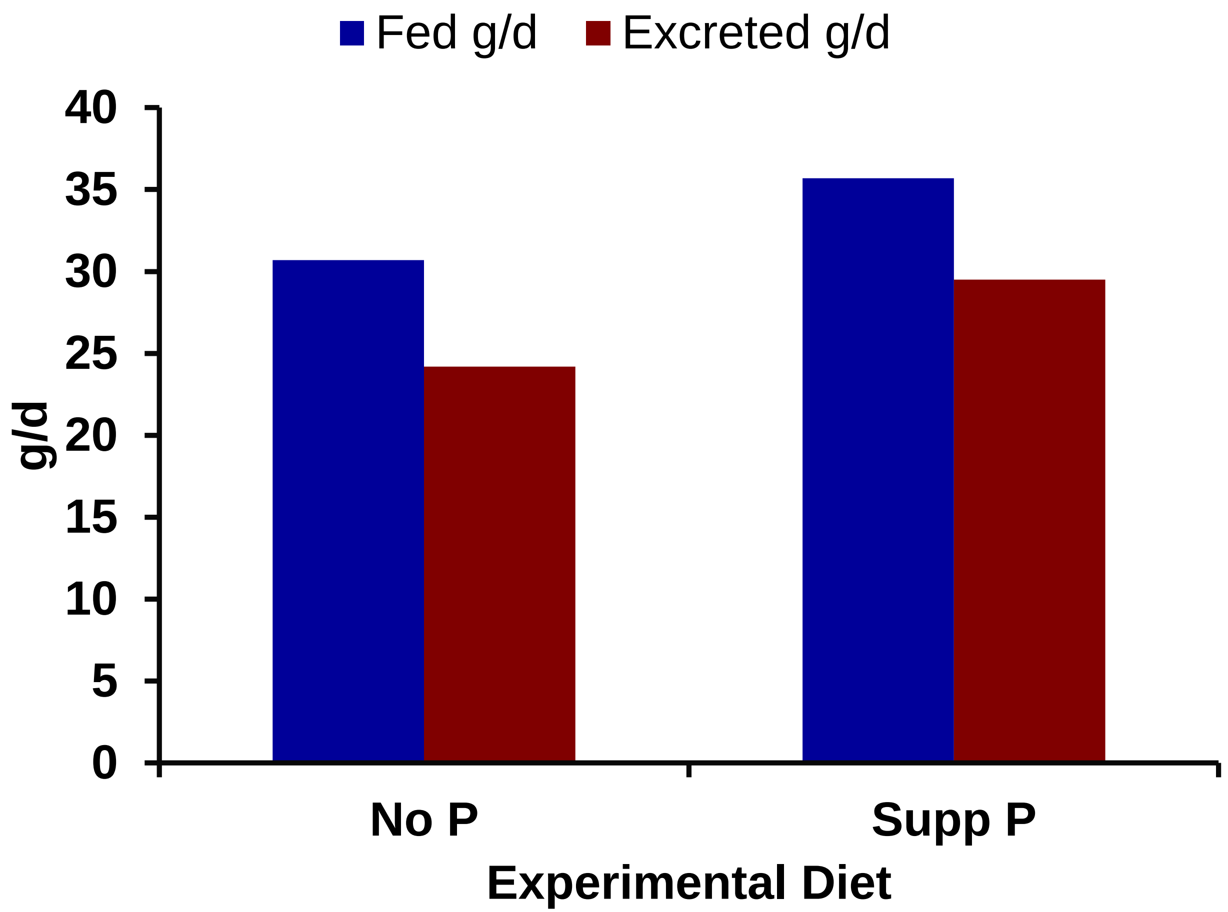
- **Evaluate the impact of adding zeolite to bedded pack dairy heifer manure**

1st Lactation Production

		Phosphorous Treatment	
		High (N=165)	Low (N=168)
305 Day Milk		18,982	18,808
ME 305 Milk		23,846	23,768
Peak Milk		75.6	75.7
Total Milk		20,598	19,978
Total Fat		810	800
Total Protein		661	645
Fat-Corrected Milk		66.5	66.3
Average Log SCC		2.82	2.95
Average MUN		14.5	14.4
Average Milking Speed		5.59	5.43

1st Lact. Reproduction and Fitness

		Phosphorous Treatment	
		High (N=174)	Low (N=173)
Age at Pregnancy		452	451
Times Bred (Heifer)		1.44	1.49
DIM at 1st Breeding		78.0	78.4
Times Bred (1st Lact.)		2.39	2.26
Days Open		146	144
Calving Ease		0.103	0.092
Birth Weight (as dam)		86.2	87.0
Gestation Length		275	275
Age at 1st Calving		727	726
Mastitis		0.36[a]	0.26[b]
Feet		0.20	0.20
Injury		0.09	0.11

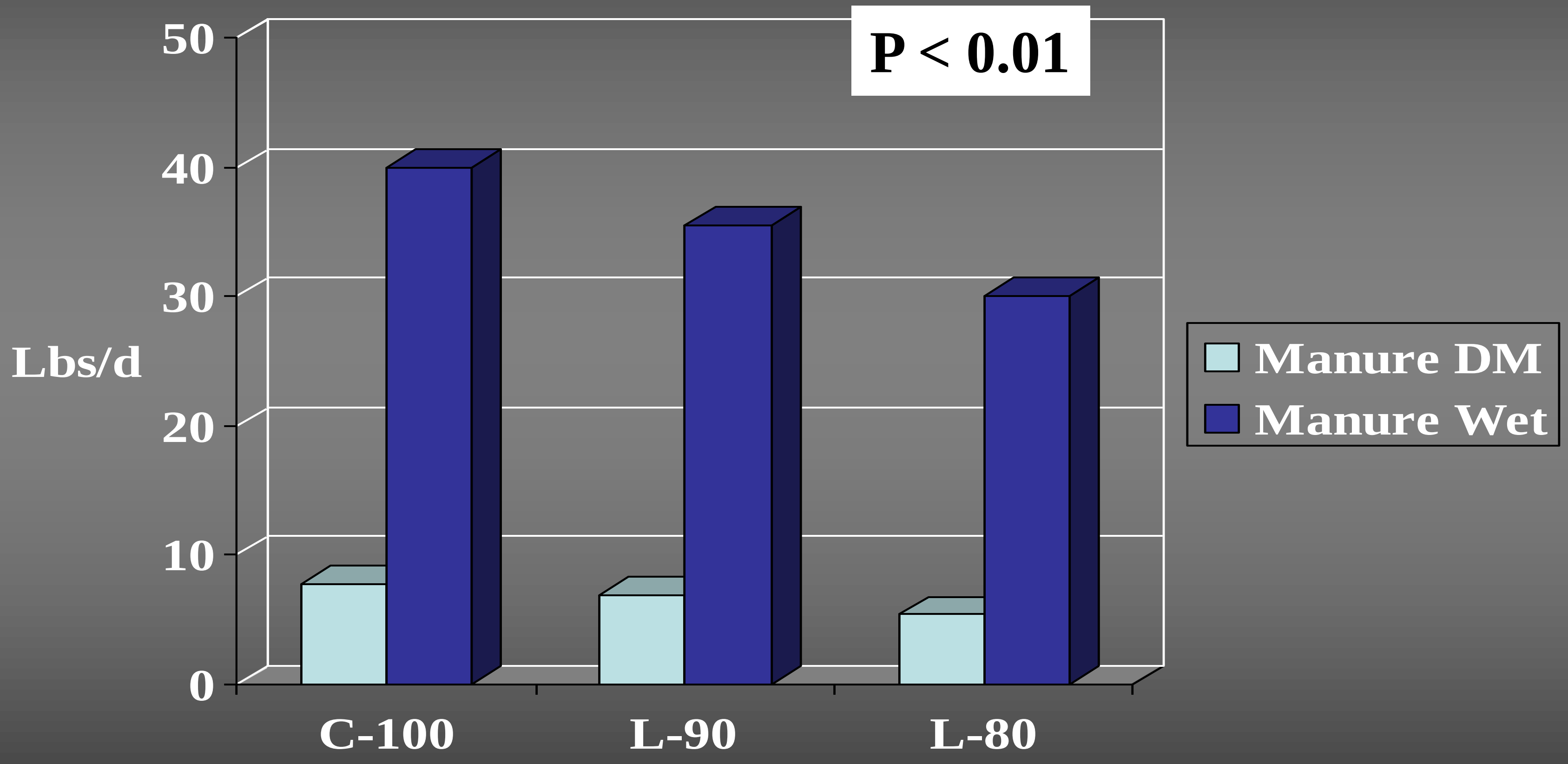


Fed g/d
Excreted g/d
40
35
30
25
20
15
10
5
0
g/d
No P
Supp P
Experimental Diet

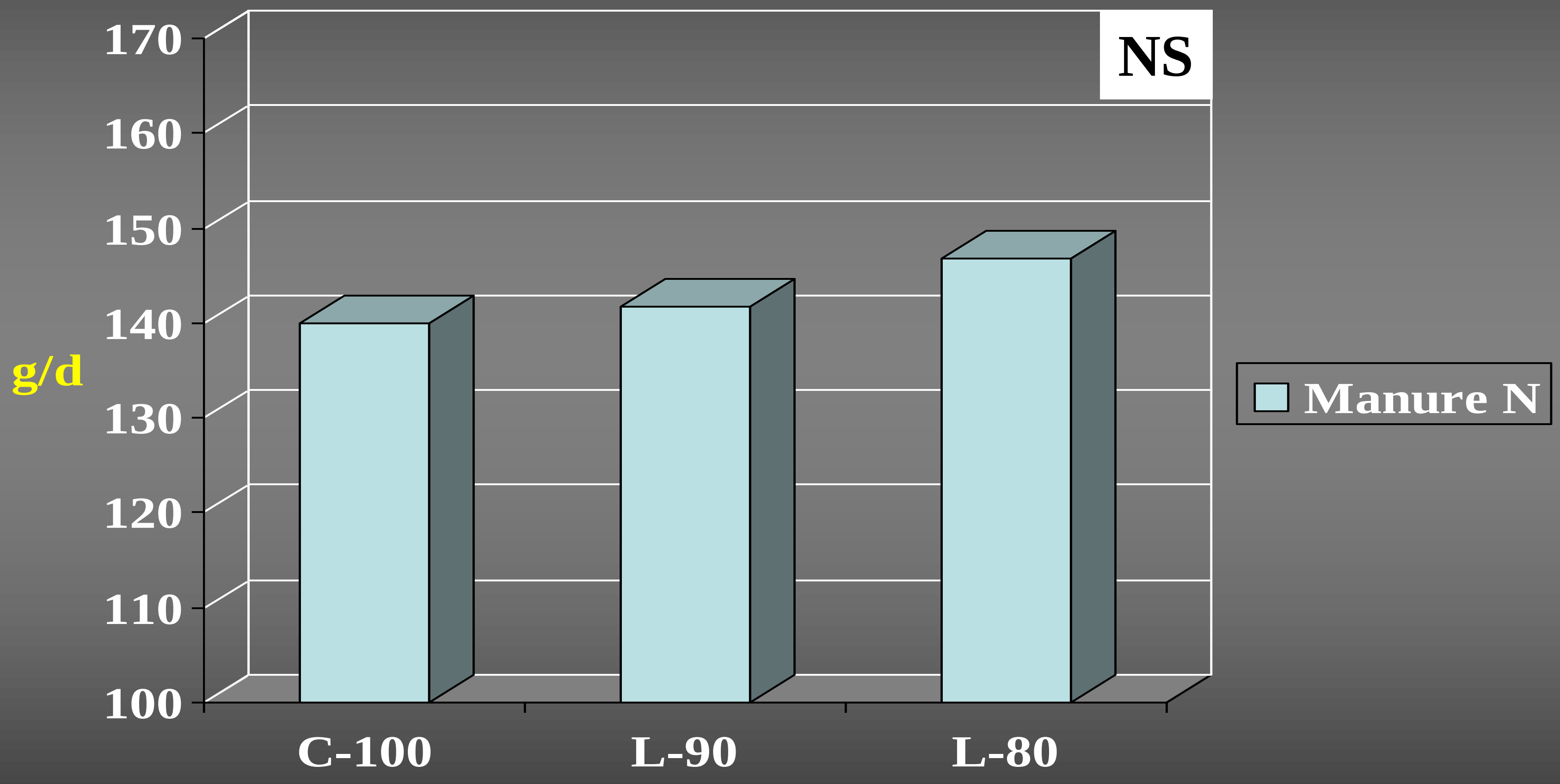
The Potential to Limit Feed Dairy Replacement Heifers

University of Wisconsin – Selected Diets

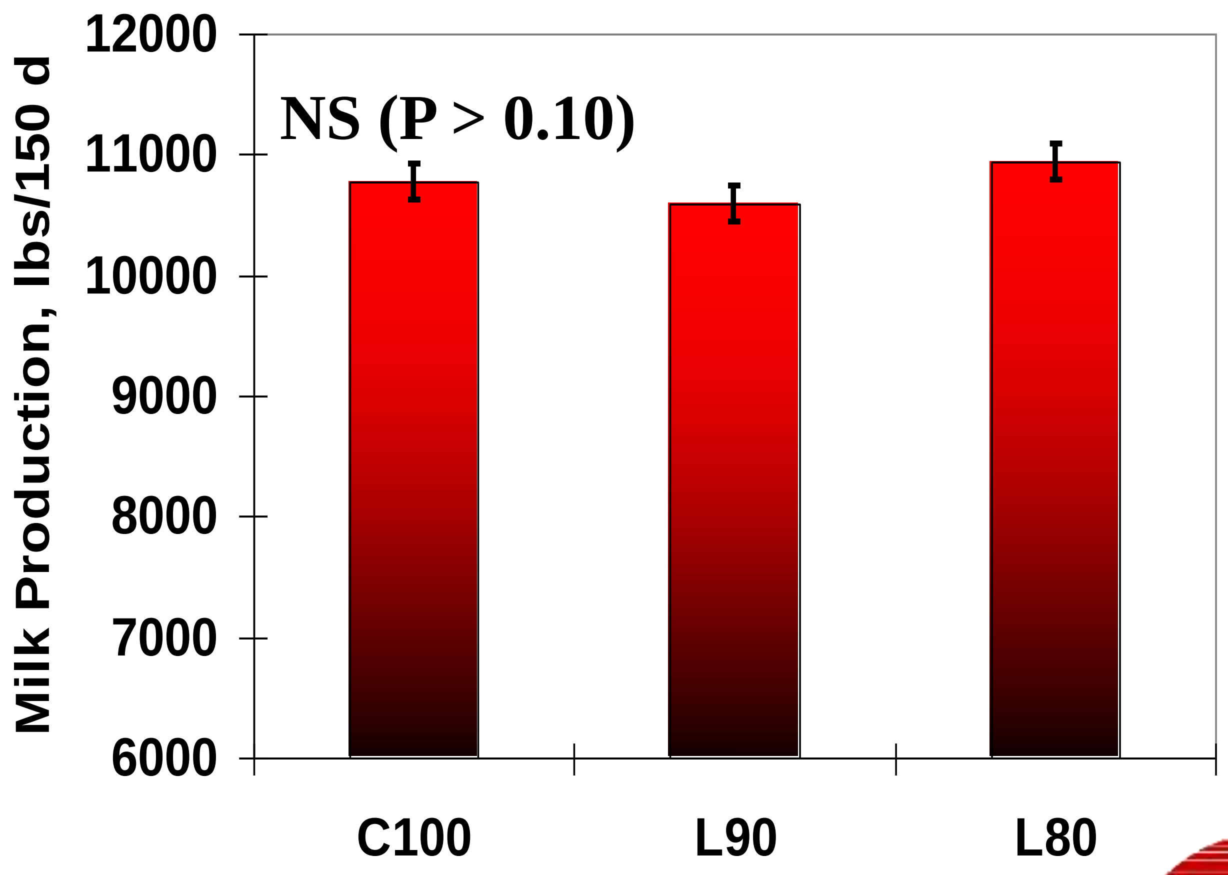
Fecal Excretion – 1100 lb Precision Fed Holstein Heifers



Nitrogen Excretion – 1100 lb Precision Fed Holstein Heifers



Milk Production: 150 DIM (3.5 % FCM):

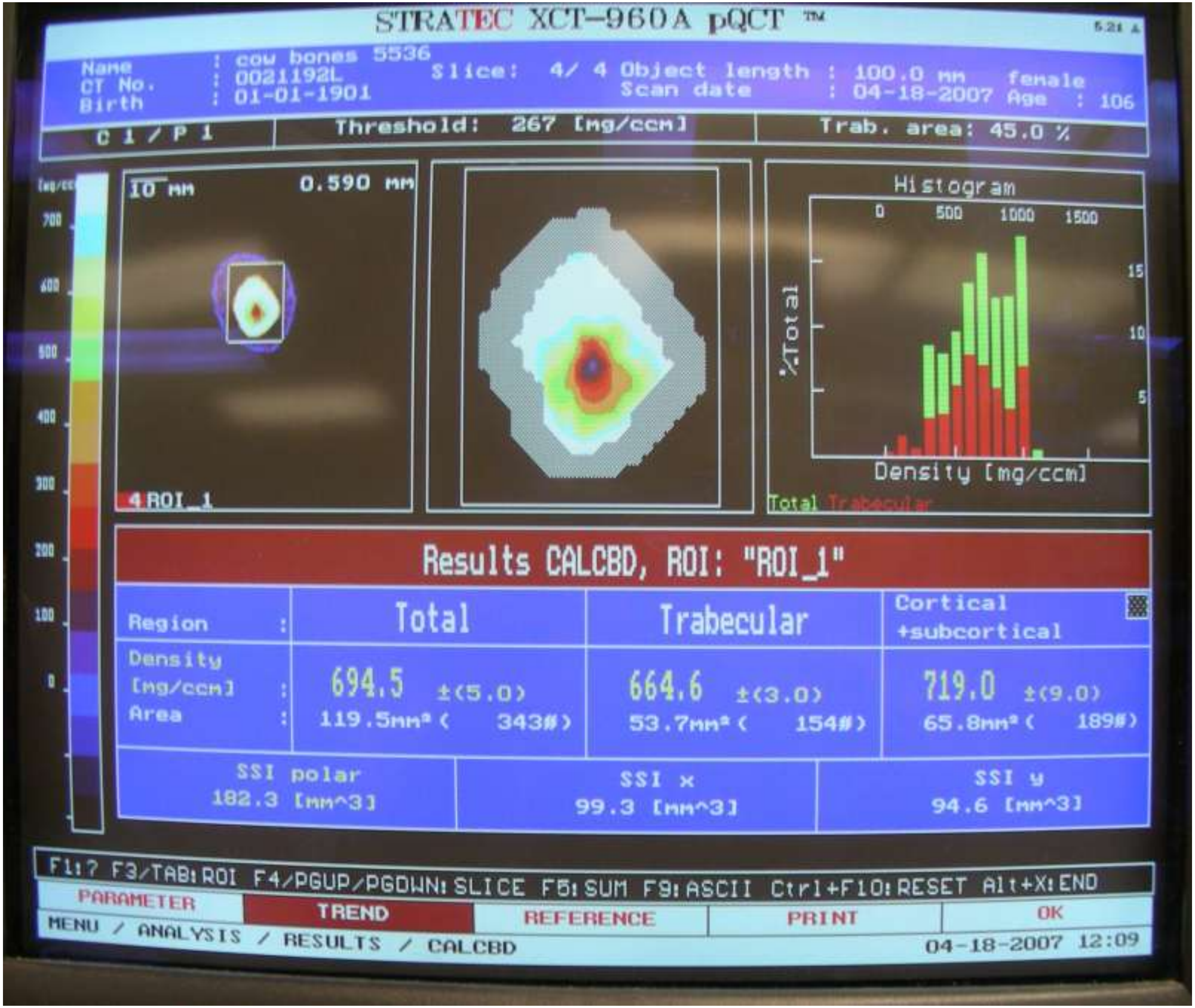


Precision Feeding – Carryover Effects

Bone development in dairy heifers fed diets with and without supplemental phosphorus.

N.M. Esser*1, P.C. Hoffman*, W.K. Coblentz†, M. W. Orth†† and K.A. Weigel*.

•Department of Dairy Science, University of Wisconsin, Madison,WI.
•† USDS-ARS Dairy Forage Research Center Marshfield and Madison, WI.
•†† Michigan State University , East Lansing, MI.


STRATEC XCT-960A pQCT ™
Name : cow bones 5536
CT No. : 0021192L
Birth : 01-01-1901
Slice: 4/ 4 Object length : 100.0 mm female
Scan date : 04-18-2007 Age : 106
C 1 / P 1
Threshold: 267 [mg/ccm]
Trab. area: 45.0 %
10 mm
0.590 mm
4 ROI_1
Histogram
%Total
Density [mg/ccm]
Total Trabecular
Results CALCBD, ROI: "ROI_1"
Region : Total Trabecular Cortical +subcortical
Density [mg/ccm] : 694.5 ±(5.0) 664.6 ±(3.0) 719.0 ±(9.0)
Area : 119.5mm² (343#) 53.7mm² (154#) 65.8mm² (189#)
SSI polar 182.3 [mm^3]
SSI x 99.3 [mm^3]
SSI y 94.6 [mm^3]
F1:? F3/TAB:ROI F4/PGUP/PGDWN:SLICE F5:SUM F9:ASCII Ctrl+F10:RESET Alt+X:END
PARAMETER TREND REFERENCE PRINT OK
MENU / ANALYSIS / RESULTS / CALCBD
04-18-2007 12:09

Holstein and Crossbred Heifers 3-22 months of age.
Experimental Diets
- **Unsupplemented = 0.28 % P**
- **Supplemented = 0.38 % P**

	0.28 % P		0.38 % P		Effect (P<
Item	Holstein	Crossbred	Holstein	Crossbred	Diet
Bone density					
Trabecular bone density,mg/cm^3	466.5	439.3	407.9	456.5	ns
Cortical bone density, mg/cm^3	573.2	588.6	628.1	562.5	ns
Total bone density, mg/cm^3	525.4	521.6	529.2	514.7	ns
Chemical composition					
P, %	10.3	10.4	10.6	10.4	0.08
Ca, %	20.2	20.5	21.0	20.4	ns
Ash, %	58.2	58.3	58.4	58.0	ns

Conclusions for limit feeding and reduced P study

- **Precision feeding decreases NEm requirements.**
- **Precision feeding increases feed efficiency and decreases fecal DM excretion.**
- **Precision feeding heifers does not alter milk yield.**
- **Precision feeding dietary P does not alter heifer frame growth, reproductive performance or subsequent milk production.**

Zeolite trial details

- **Dairy heifer manure using wood product bedded pack system**
- **Added zeolite at a rate to achieve 6.25% in manure**
- **Fall and spring manure applications compared – 20 t/a rate applied**
- **Corn grown as the test crop**
- **Residual effect monitored in the year following application – 2nd yr. corn**

What is Zeolite?

What is Zeolite

- **Zeolite is a naturally occurring mineral group consisting of over 50 different minerals. It consists of special crystalline structure that is porous but remains rigid in the presence of water**

- **Compositionally similar to clay minerals (both alumino-silicates) but differ in their crystalline structure**

- **Many clays have a layered crystalline structure (similar to a deck of cards) and are subject to shrinking and swelling. In contrast, zeolite has a rigid 3-D crystalline structure (similar to a honeycomb)**

St. Cloud Zeolite

- **a low clay, low sodium mineral which behaves as a molecular sieve, attracting and binding compounds including ammonia**

- **holds water, or urine molecules in it's lattice structure which helps reduce manure moisture levels**

- **research claims include:**
  - **increased rumen pH in a ruminant diet**
  - **reduced amount of manure N lost by 65%**
  - **adding 6.25% zeolite to manure slurry reduced ammonia loss by 55%**
  - **including 2% zeolite in a poultry diet resulted in a 40% increase in manure N and a 102% improvement in manure TKN:P ratios**
  - **Zeolite added to soils resulted in reduced N leaching through the root zone and a doubling of water holding capacity**

Manure Nutrient Characteristics

- **2008 manure**
  - **average first year available N - 2.85 lbs/t**
  - **average 27% of total N as NH_4-N**
  - **C:N ratio approximately 27:1**

- **2009 manure**
  - **average first year available N – 3.38 lbs/t**
  - **average 23% of total N as NH_4-N**
  - **C:N ratio of approximately 25:1**

Treatments – year of manure application

- **Year 1 – 2008**

- **Control – no manure or N fertilizer**
- **Commercial N – 90, 120 and 150 lbs/a**
- **Fall manure from limit fed heifers – with and without zeolite in bedding**
- **Fall manure from full fed heifers – with and without zeolite in bedding**
- **Spring manure from full fed heifers – with and without zeolite in bedding**

- **Year 2 – 2009**

- **Control – no manure or N fertilizer**
- **Commercial N – 30, 60 and 90 lbs/a**
- **Fall manure from full fed heifers – with and without zeolite in bedding**
- **Fall manure from full fed heifers – with 2X zeolite in bedding + in field**
- **Spring manure from full fed heifers – with and without zeolite in bedding**

Zeolite mixed with wood shavings

Zeolite periodically stirred then collected and weighed

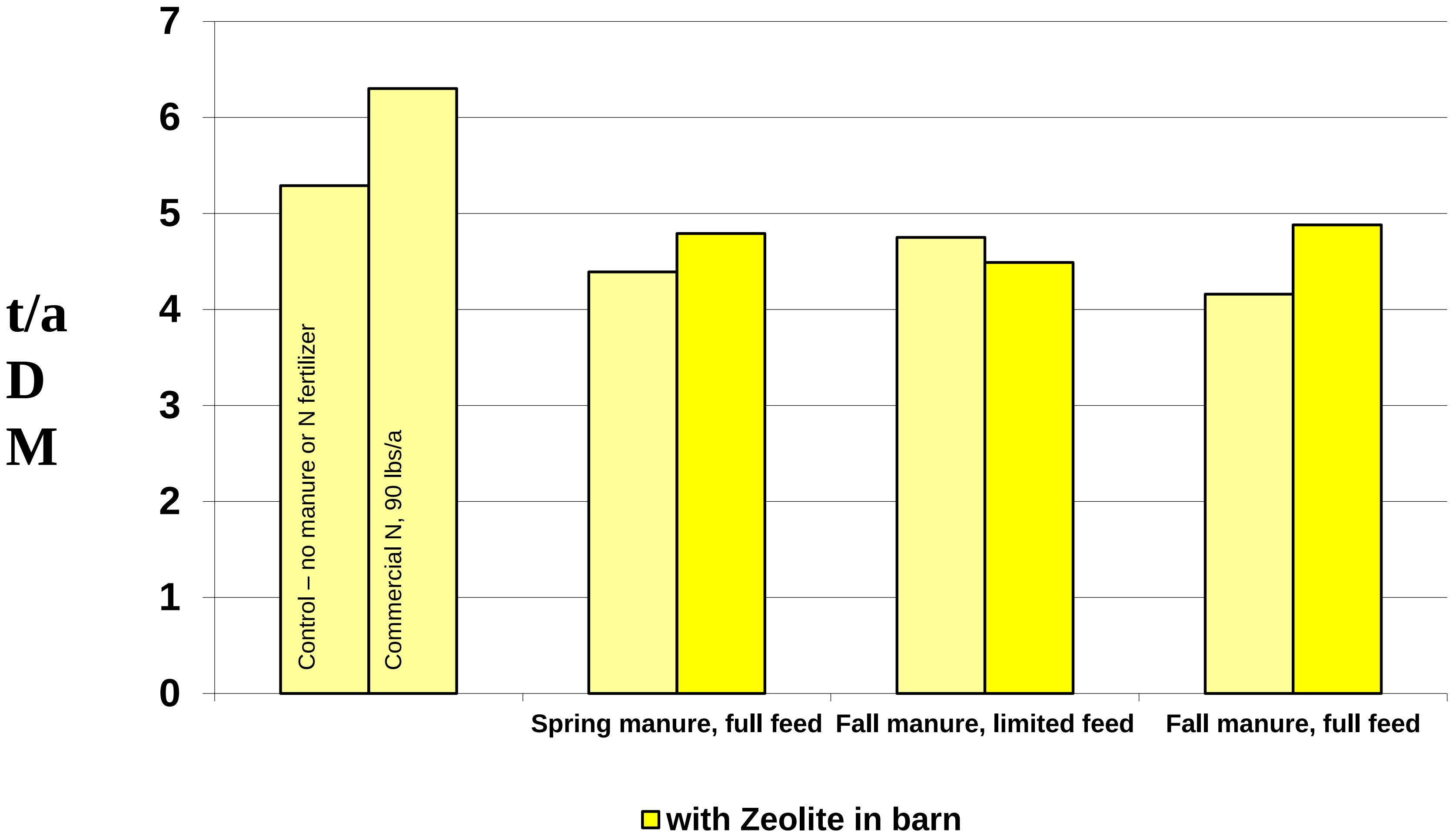
Zeolite thoroughly mixed prior to land application



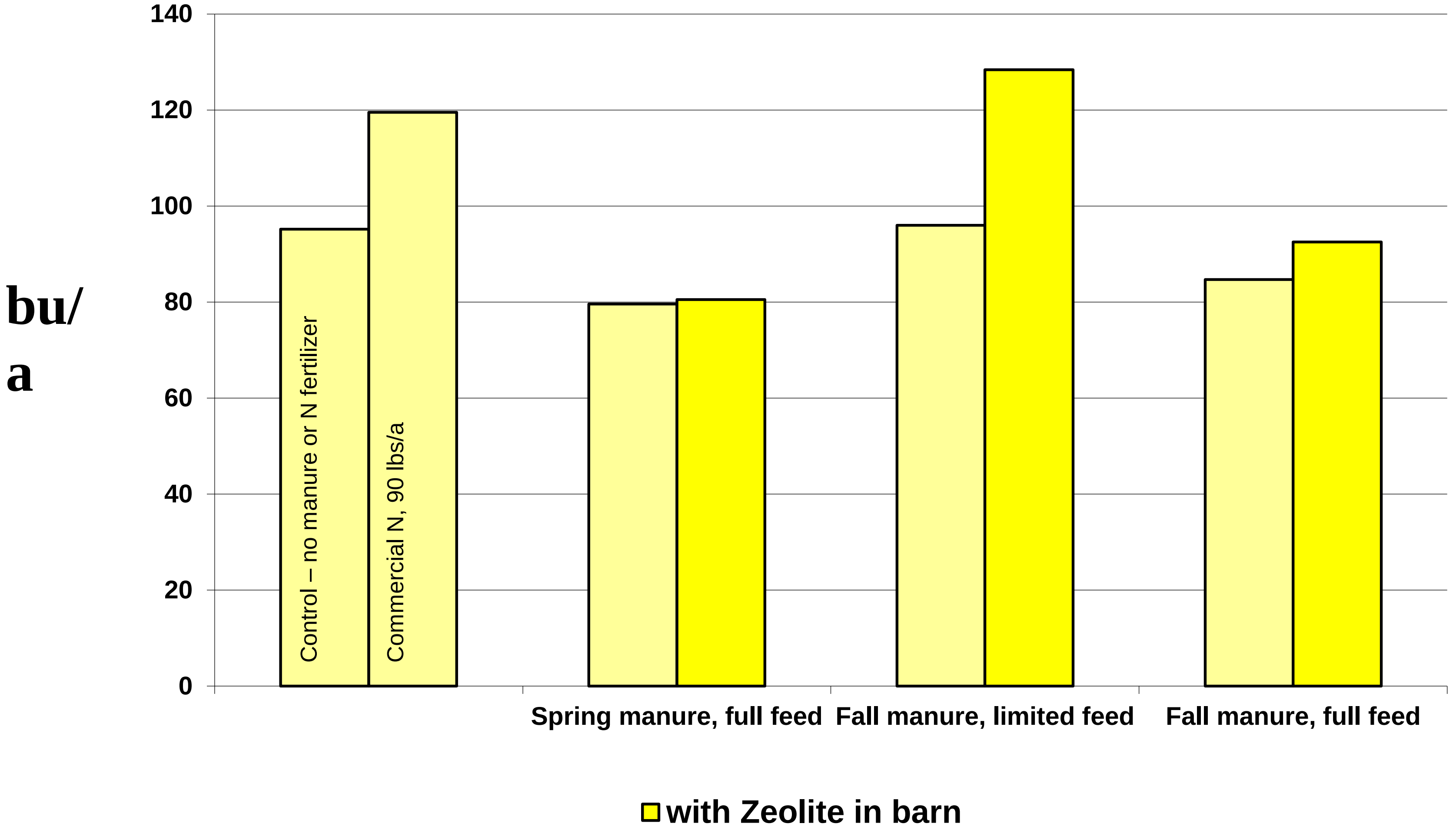

Zeolite applied at 20 t/a rate

Ammonia and weather monitoring

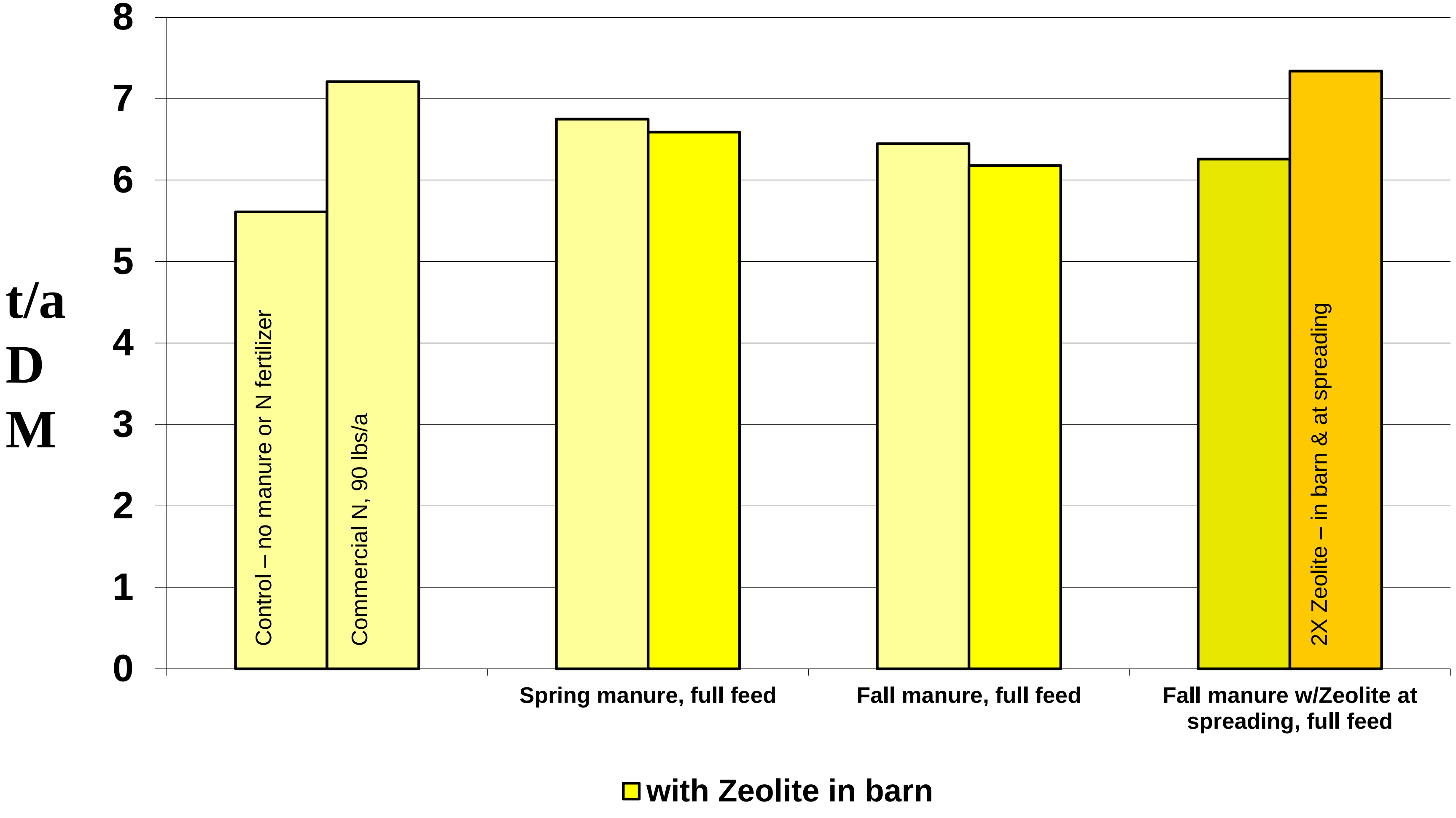
Effect of Zeolite treatments on first year corn silage yield. Marshfield, WI 2008



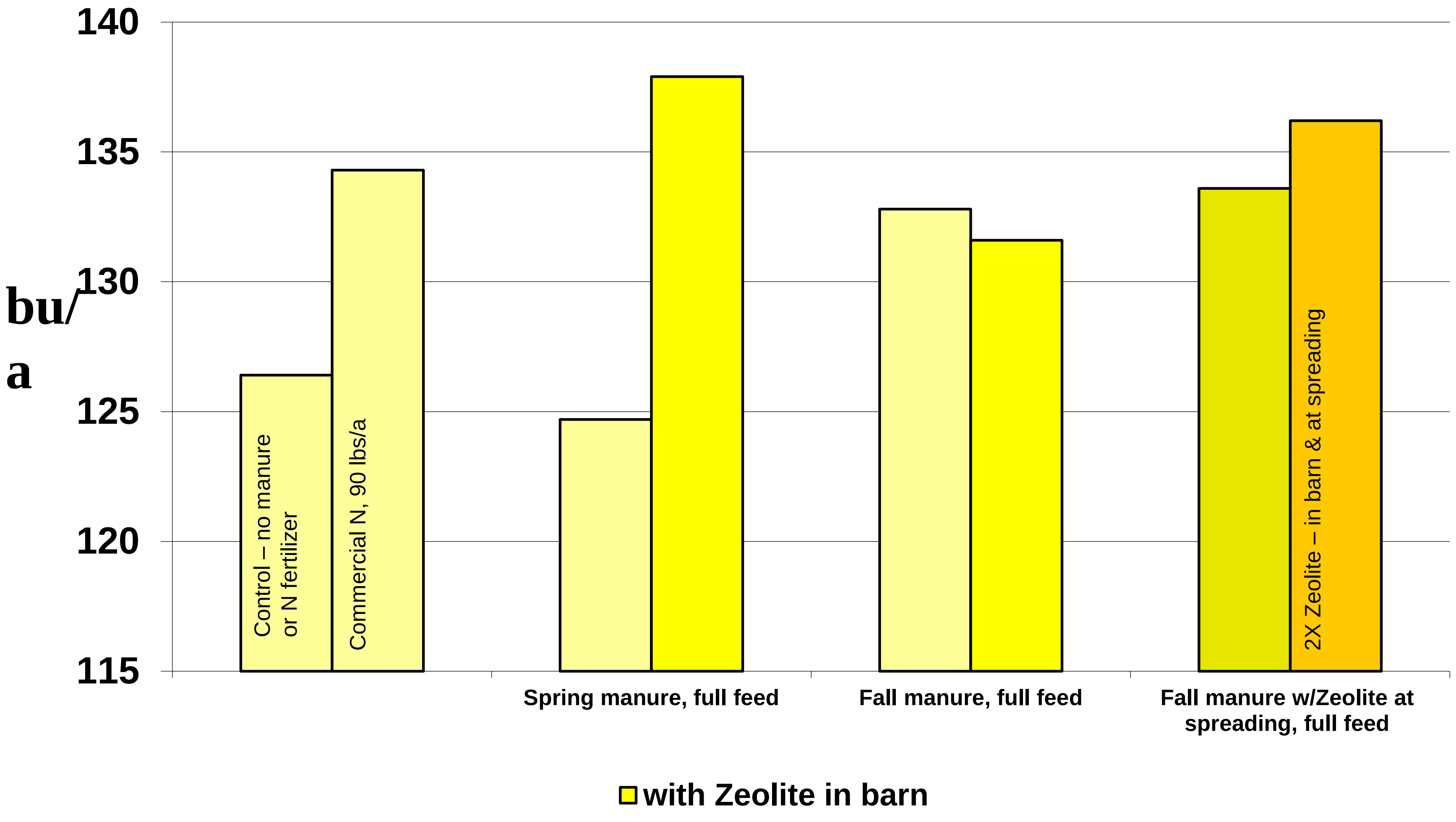
Effect of Zeolite treatments on first year corn grain yield. Marshfield, WI 2008



Effect of Zeolite treatments on first year corn silage yield.
Marshfield, WI 2009



Effect of Zeolite treatments on first year corn grain yield.
Marshfield. WI 2009



Meta-analysis of Zeolite treatments on corn grain and silage yield in year of application.
Marshfield, WI 2008-2009.

		Grain yield, bu/a		Silage yield, tons DM/a	
Zeolite	N Source	x	SE	x	SE
No	Fertilizer	128.9	18.74	6.72	0.93
No	Manure	113.9	16.71	5.42	0.90
Yes	Fertilizer	126.7	18.74	6.73	0.93
Yes	Manure	112.4	16.71	5.76	0.90
		Pr>F		Pr>F	
Zeolite		0.82		0.48	
N Source		0.11		0.01	
Zeolite x N Source		0.97		0.51	

NS = > 0.10

Summary for Zeolite study

- The heifer manure used in this study was relatively low in total N and NH_4-N with a relatively high C:N ratio

- Unfavorable weather and poor mineralization reduced corn yields in 2008 when manure was the N source
  Ear leaf N in 2008 – 1.94% for control, 1.94% ave. for all manure trts. and 2.36% where commercial N was used

- In 2009, manure and commercial N resulted in similar corn yields

- Zeolite had no impact on corn yields in the year following application of the manure containing zeolite

- Future work should focus on traditional dairy manure which typically contains higher levels of N and ammonium-N