Ethanol byproducts use for feedlot cattle

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& many students

Utilization of Corn Co-Products in the Beef Industry

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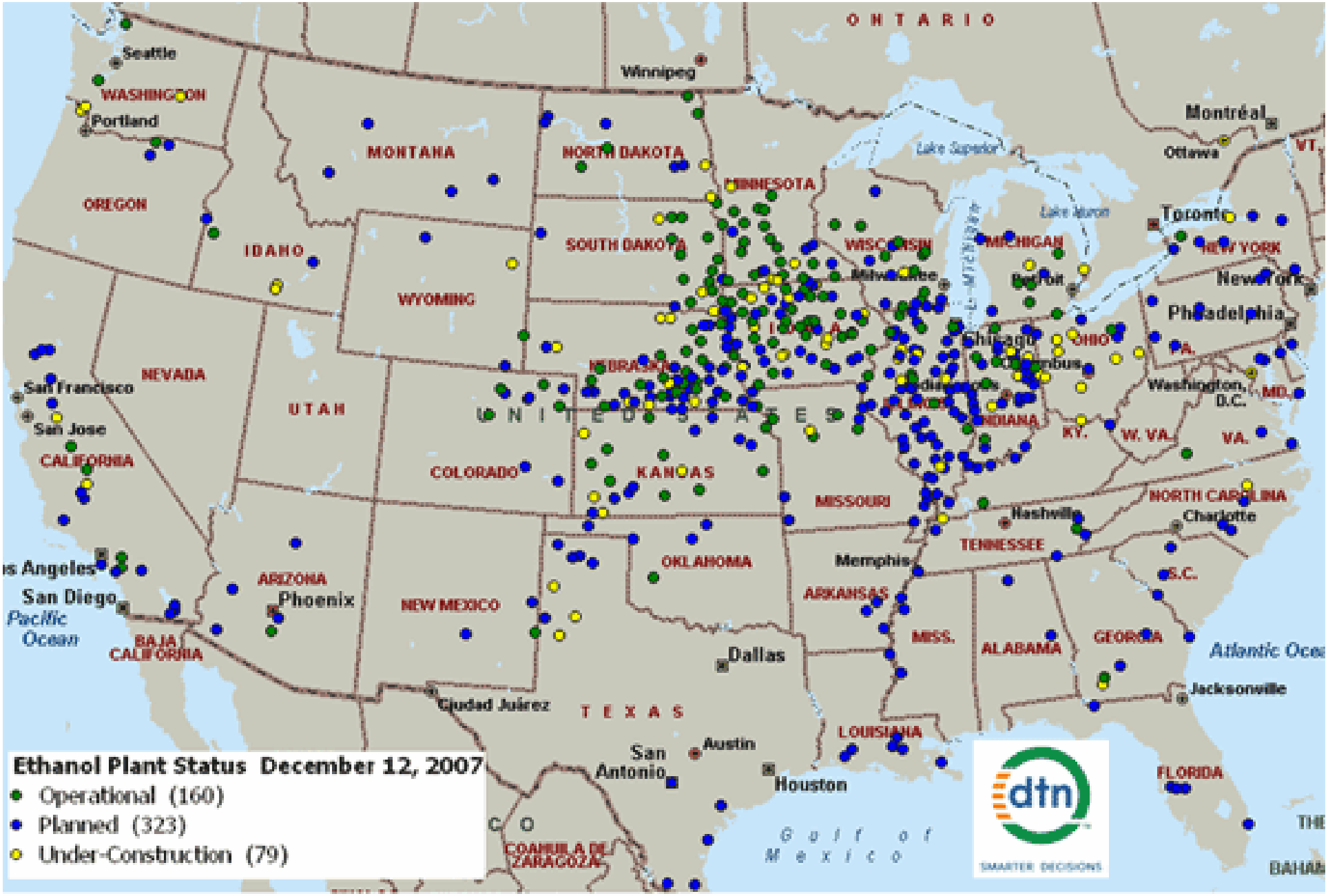
NEBRASKA CORN BOARD

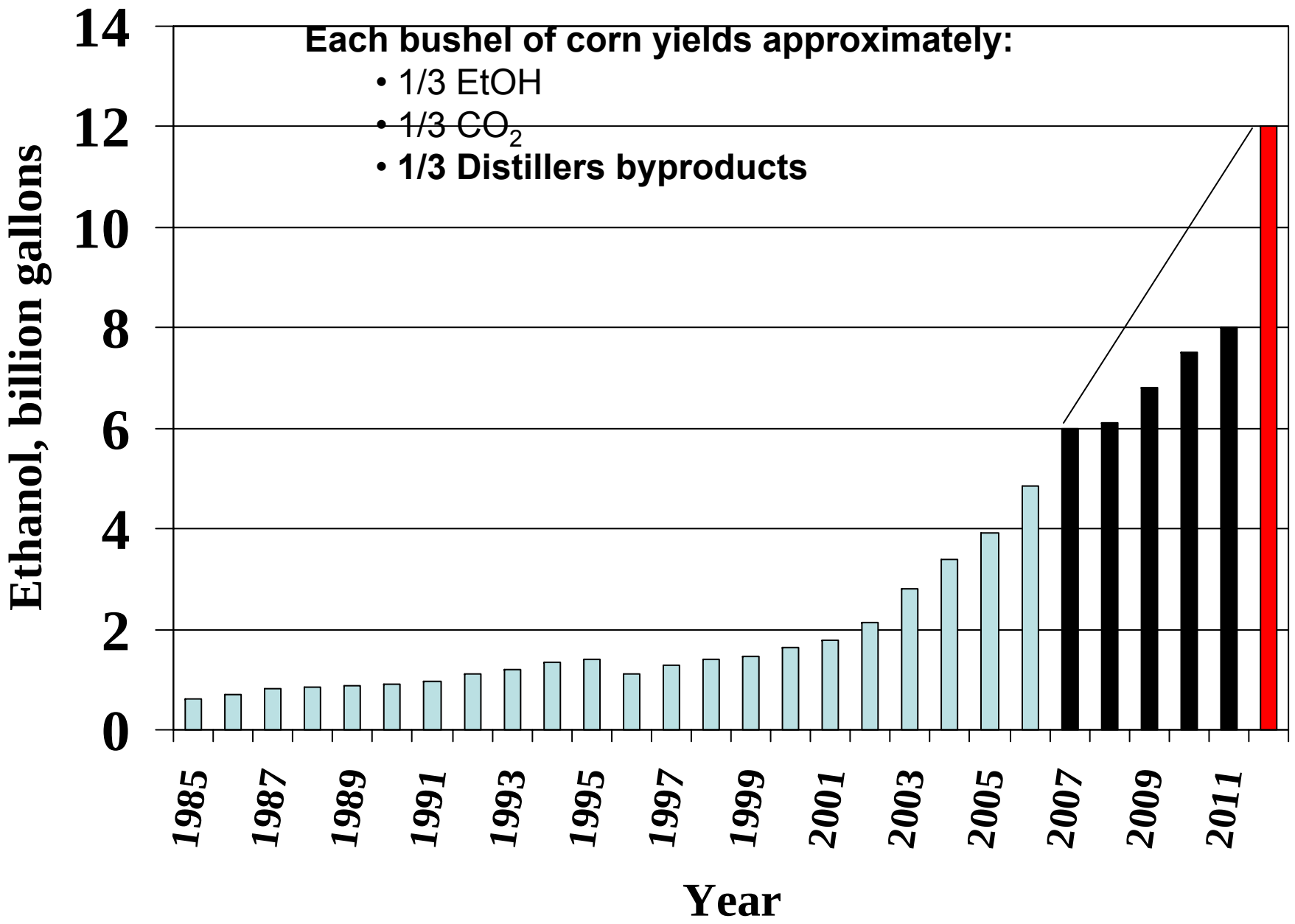
University of Nebraska Lincoln

A joint project of the Nebraska Corn Board and the University of Nebraska–Lincoln Institute of Agriculture and Natural Resources

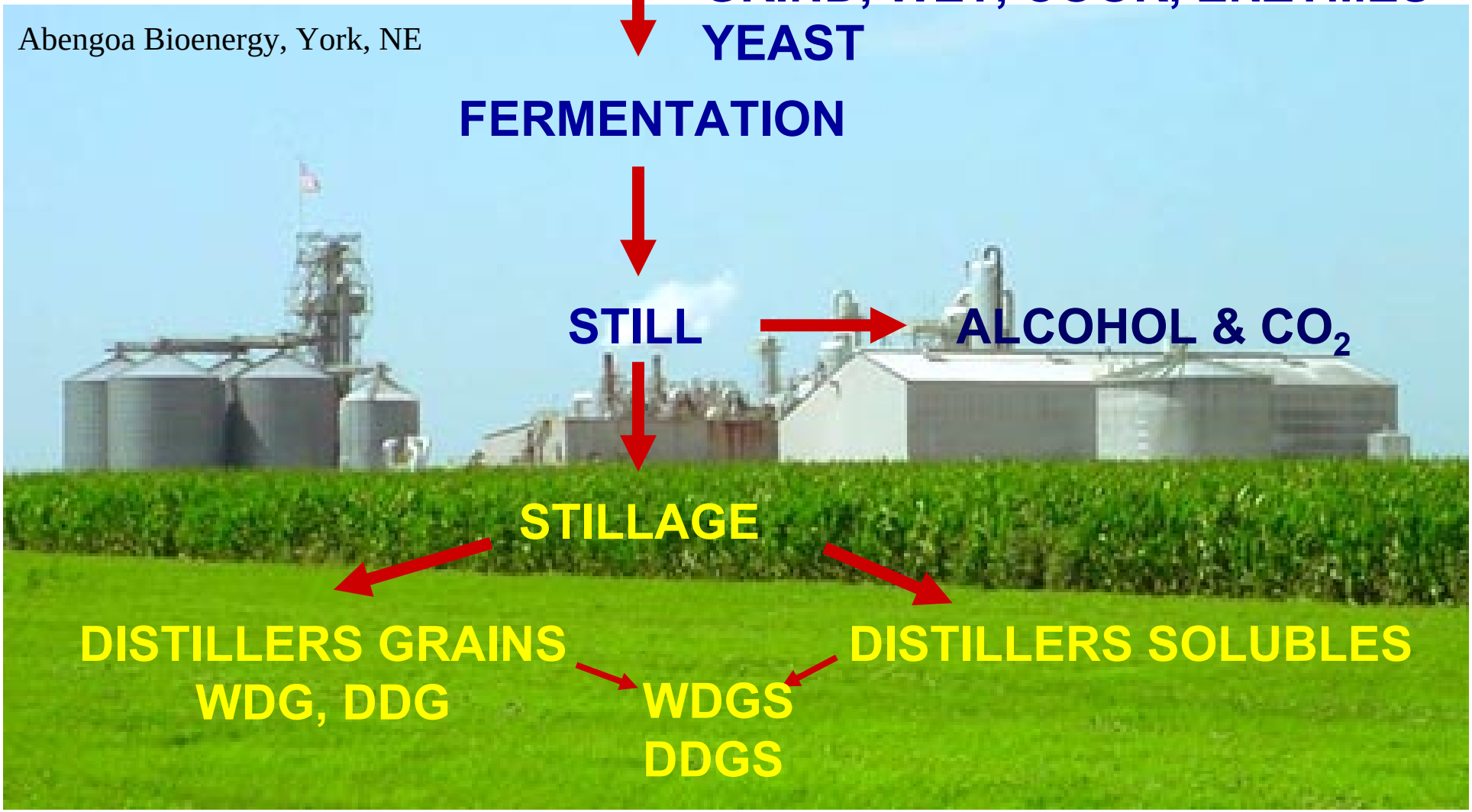


*Alaska has one ethanol plant in the planning stage
*Hawaii has two ethanol plants in the planning stage

DTN Ethanol Center Website: http://www.dtnethanolcenter.com/index.cfm

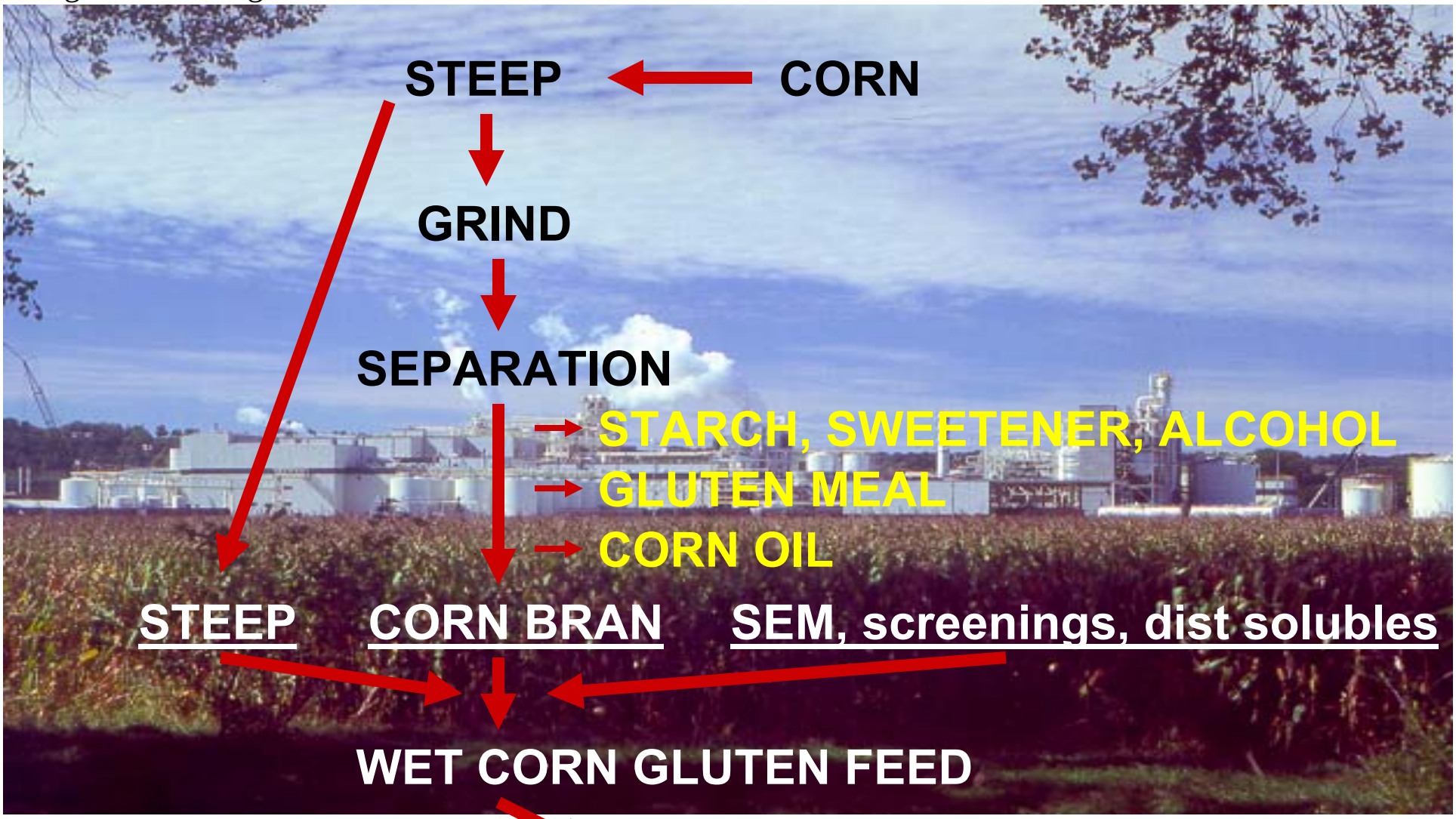

Each bushel of corn yields approximately:
• 1/3 EtOH
• 1/3 CO_2
• 1/3 Distillers byproducts
Ethanol, billion gallons
0
2
4
6
8
10
12
14
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
Year

DRY MILLING-WDG(+S)



WET MILLING-CGF

Cargill wet milling, Blair, NE



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Byproducts

- WDGS, modified (45% DM)
- WDGS, traditional (35% DM)
- DDGS (90% DM)
- Syrup, distillers solubles, CCDS

- WCGF (45% DM)
- WCGF-Sweet Bran (60% DM)
- DCGF
- Steep

- “new” distillers grains

Byproduct composition

	DM	CP	UIP	P
corn	85-90	8-10	40-60	.25-.35
DDGS	85-90	28-35	65	.7-.9
WDGS	30-35	28-35	65	.7-.9
ModDG	42-50	28-35	65	.7-.9
CCDS	25-35	20-25	30	1.0-1.5
WCGF	40/60	16-24	20	.8-1.1

Fat: 3-4% in corn, 10-12% in DGS, 3.0% in WCGF

Sulfur: 0.15% in corn, 0.4-0.5% in WCGF,
.45 to 2.0% in DGS (average 0.7 to 0.8%)

Nutrient Averages (All Plants)

- 31.0% CP
- 11.9% Fat
- 0.83% P
- 0.77% S

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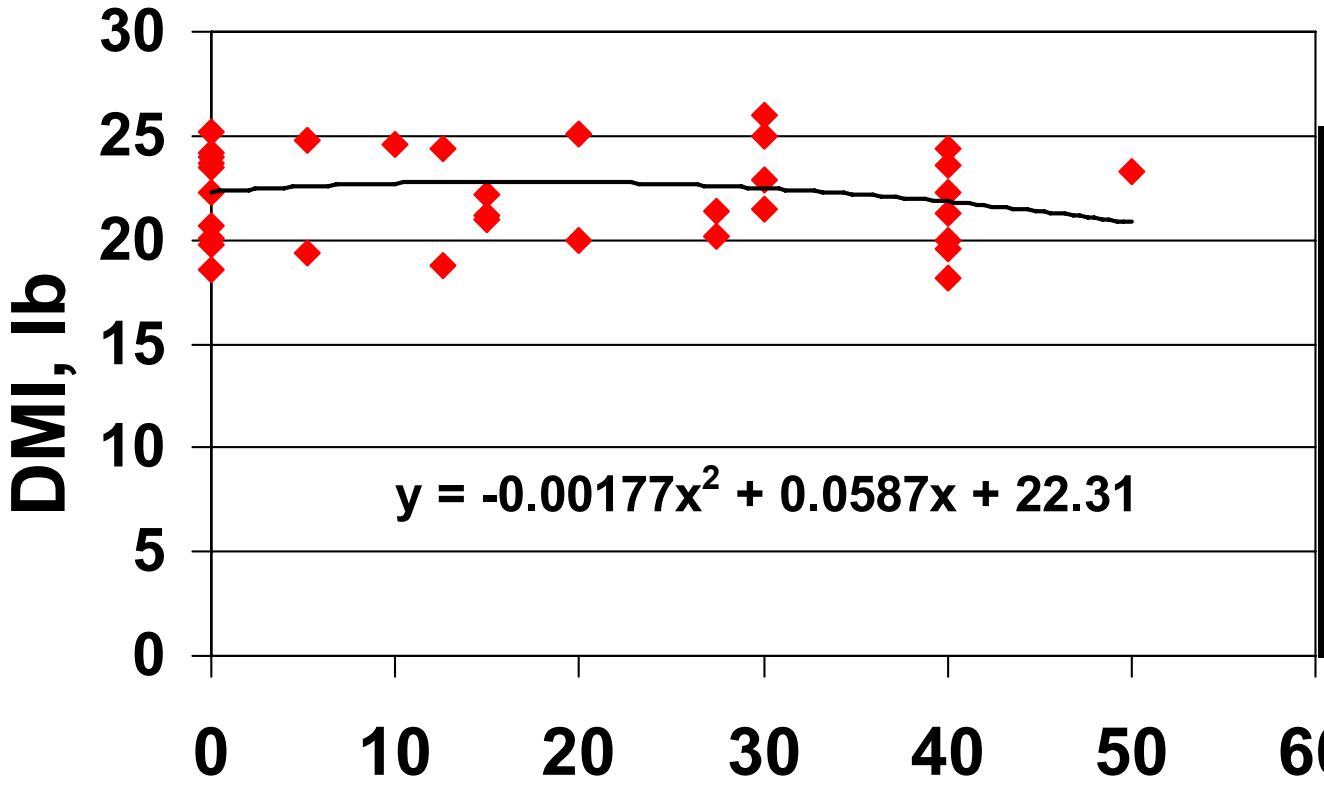
Use

- Inclusion < 15% (2-3 lb): protein
- Inclusion > 15% (4+ lb): energy

UNL Studies Used

Experiment	Year	Diet DM % WDGS	Hd/Tx
Sindt et al.	1990	0, 5.2, 12.6, 40	40
Larson et al.	1991	0, 5.2, 12.6, 40	40
Ham et al.	1992	0, 40	32
Fanning et al.	1997	0, 30	20
Vander Pol et al.	2002	0, 20, 40	10
Vander Pol et al.	2004	0, 10, 20, 30, 40, 50	48
Buckner et al.	2005	0, 30	50
Corrigan et al.	2005	0, 15, 27.5, 40	40
Luebbe et al.	2005	0, 15, 30	32

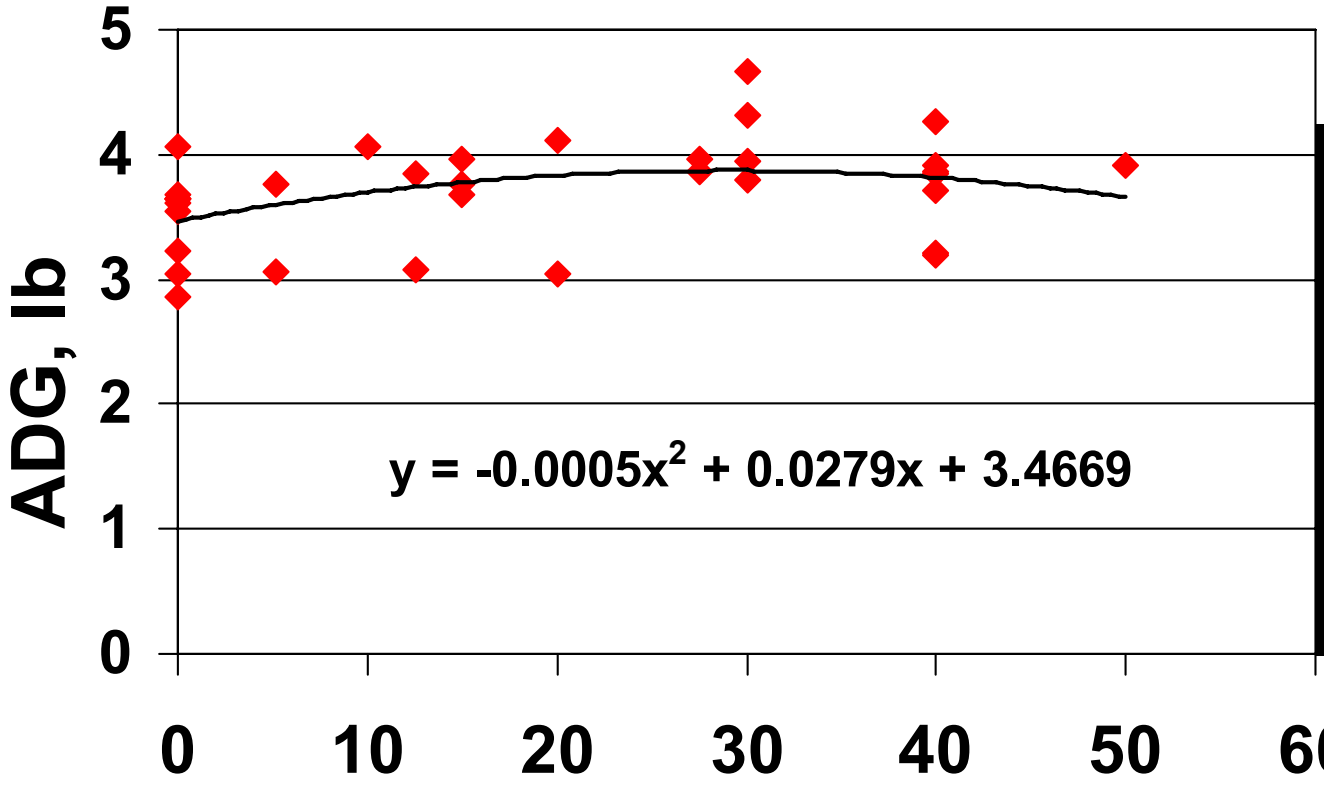
Dry Matter Intake



Predicted Values	
WDGS Level	DMI (lb)
0	22.31
10	22.72
20	22.78
30	22.48
40	21.83
50	20.82

Linear P = 0.01
Quadratic P = 0.01

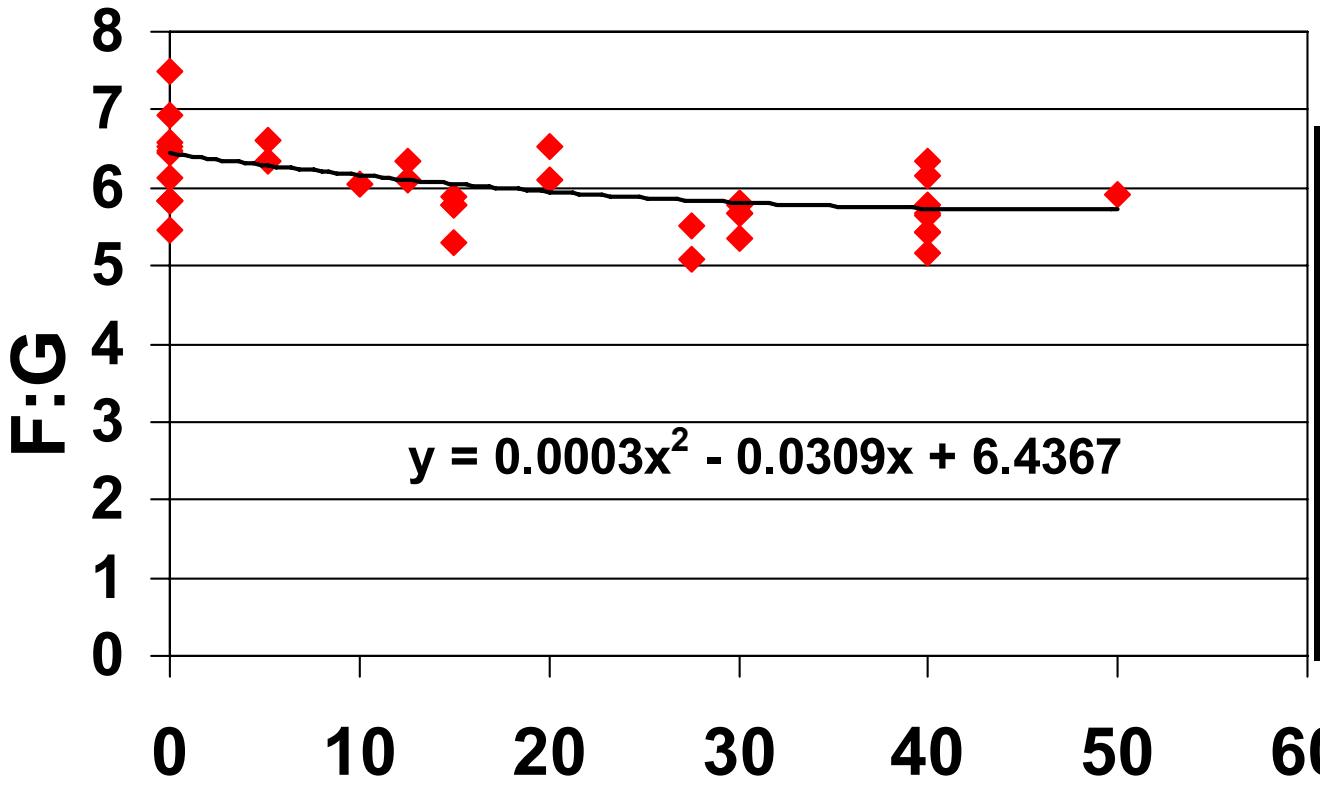
Average Daily Gain



Predicted Values	
WDGS Level	ADG (lb)
0	3.47
10	3.70
20	3.83
30	3.87
40	3.81
50	3.66

Linear P < 0.01
Quadratic P < 0.01

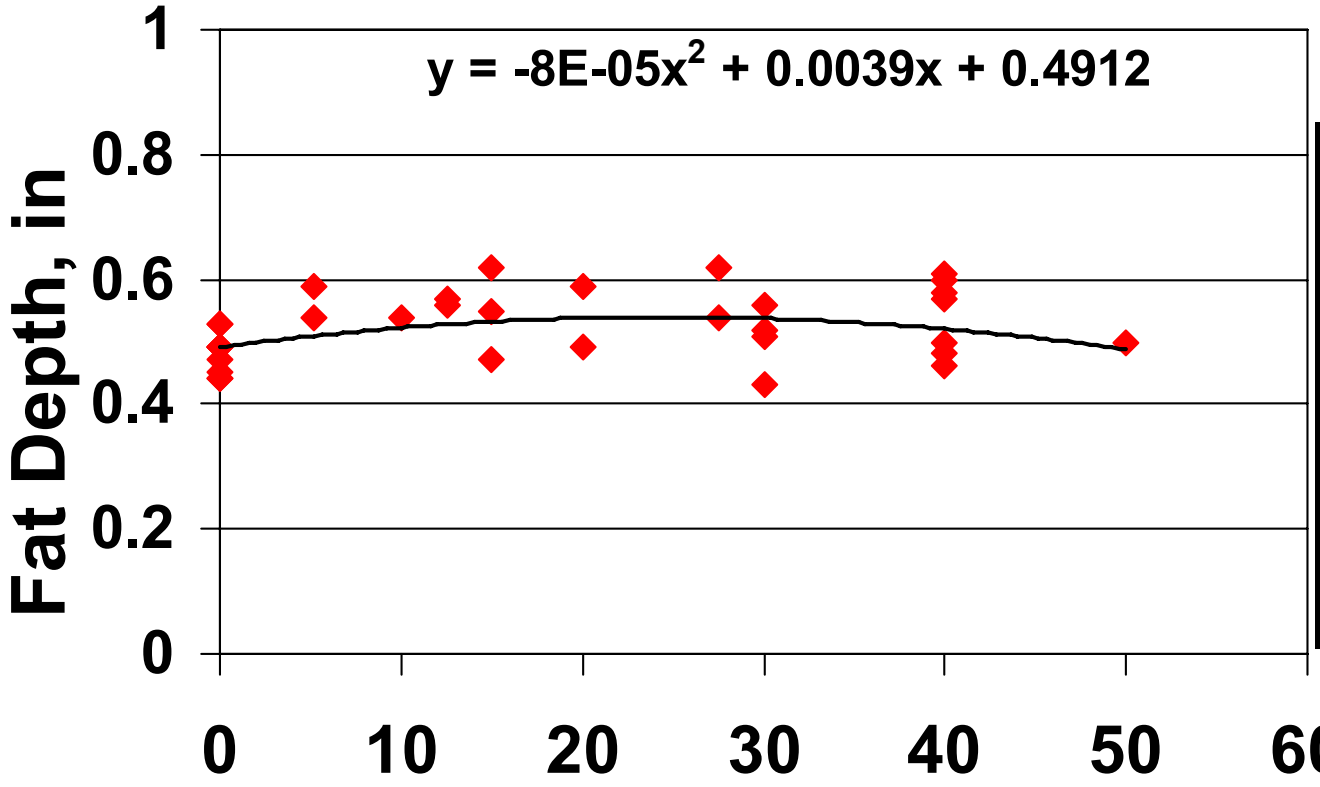
Feed Conversion



Predicted Values	
WDGS Level	**F:G**
0	6.44
10	6.16
20	5.95
30	5.81
40	5.74
50	5.73

Linear P < 0.01
Quadratic P = 0.09

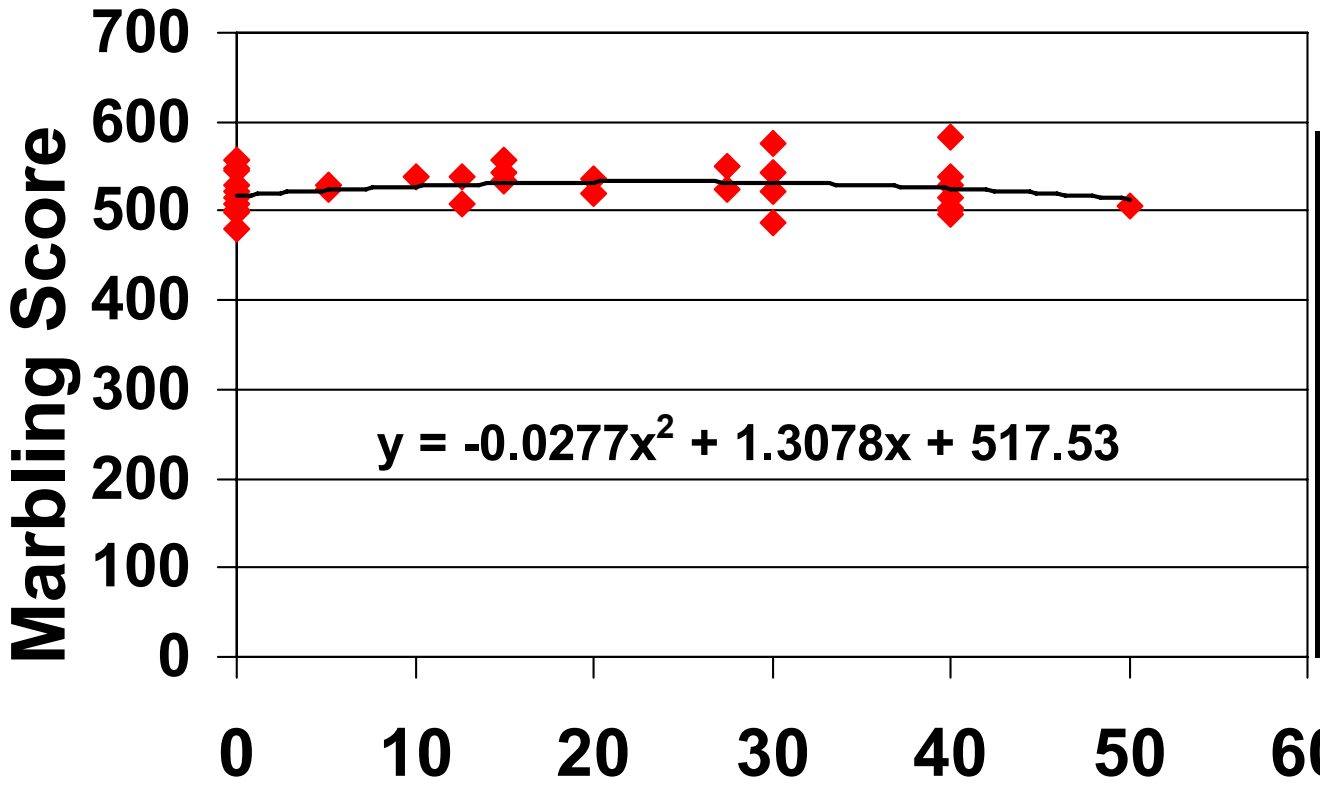
12th Rib Fat Depth



Predicted Values	
WDGS Level	FAT
0	0.49
10	0.52
20	0.54
30	0.54
40	0.52
50	0.49

Linear P < 0.01
Quadratic P = 0.04

Marbling Score



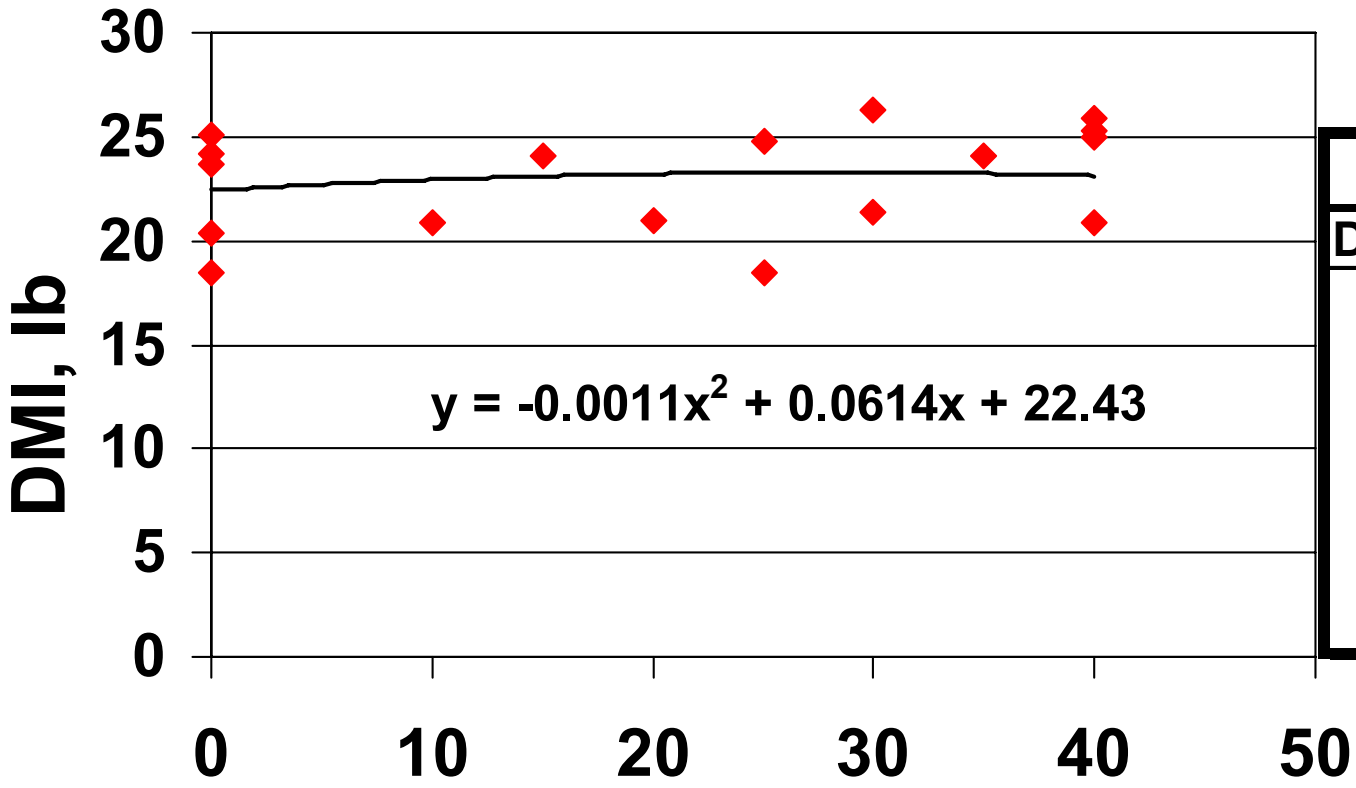
Predicted Values	
WDGS Level	**Marbling**
0	518
10	528
20	533
30	532
40	526
50	514

Linear P = 0.05
Quadratic P = 0.05

Studies Used

Experiment	Year	Diet DM % DDGS	Hd/Tx
Benson et al.	2005	0, 15, 25, 35	48
Bremer et al.	2005	0, 30	60
Buckner et al.	2007	0, 10, 20, 30, 40	40
Ham et al.	1994	0, 40	32
May et al.	2007	0, 25	96

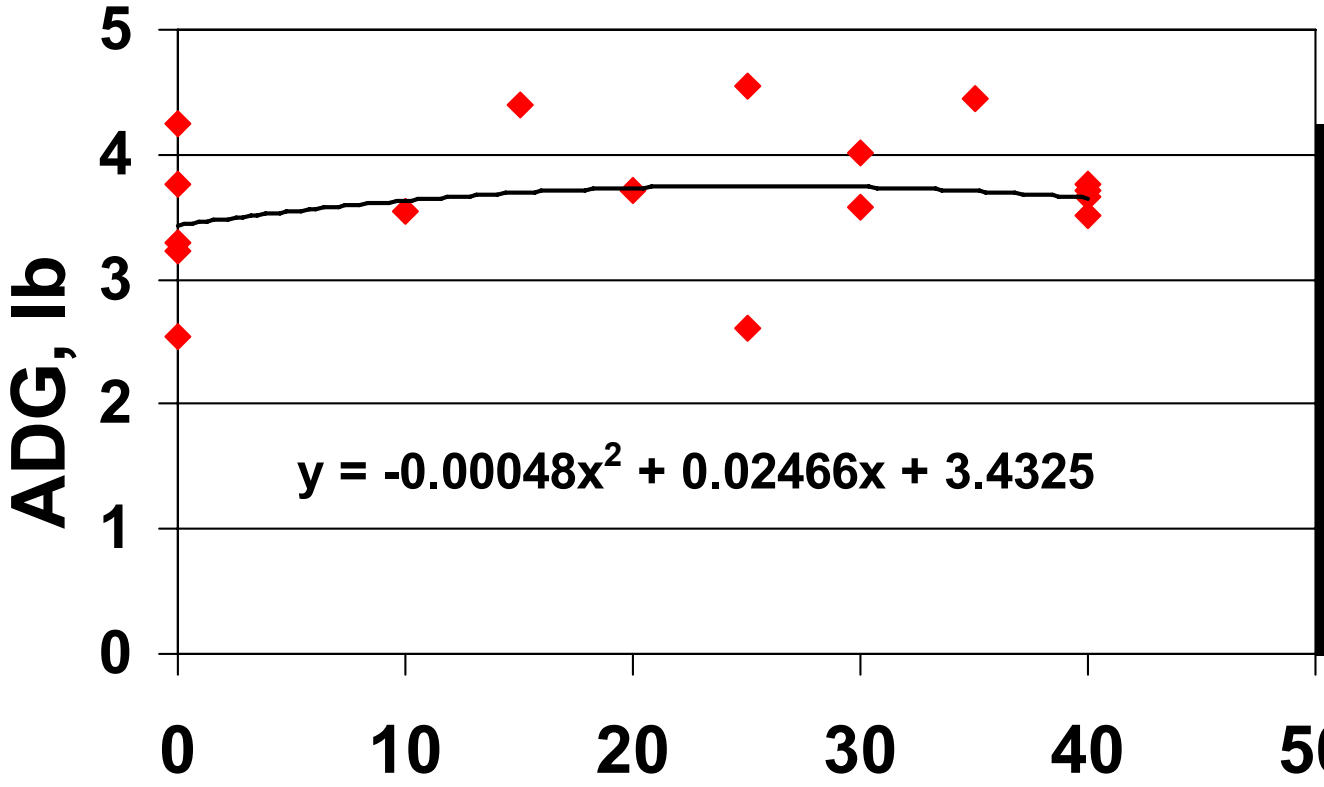
Dry Matter Intake



Predicted Values	
DDGS Level	DMI (lb)
0	22.43
10	22.93
20	23.22
30	23.38
40	23.13

Linear	P = 0.01
Quadratic	P = 0.08
Cubic	P = 0.68

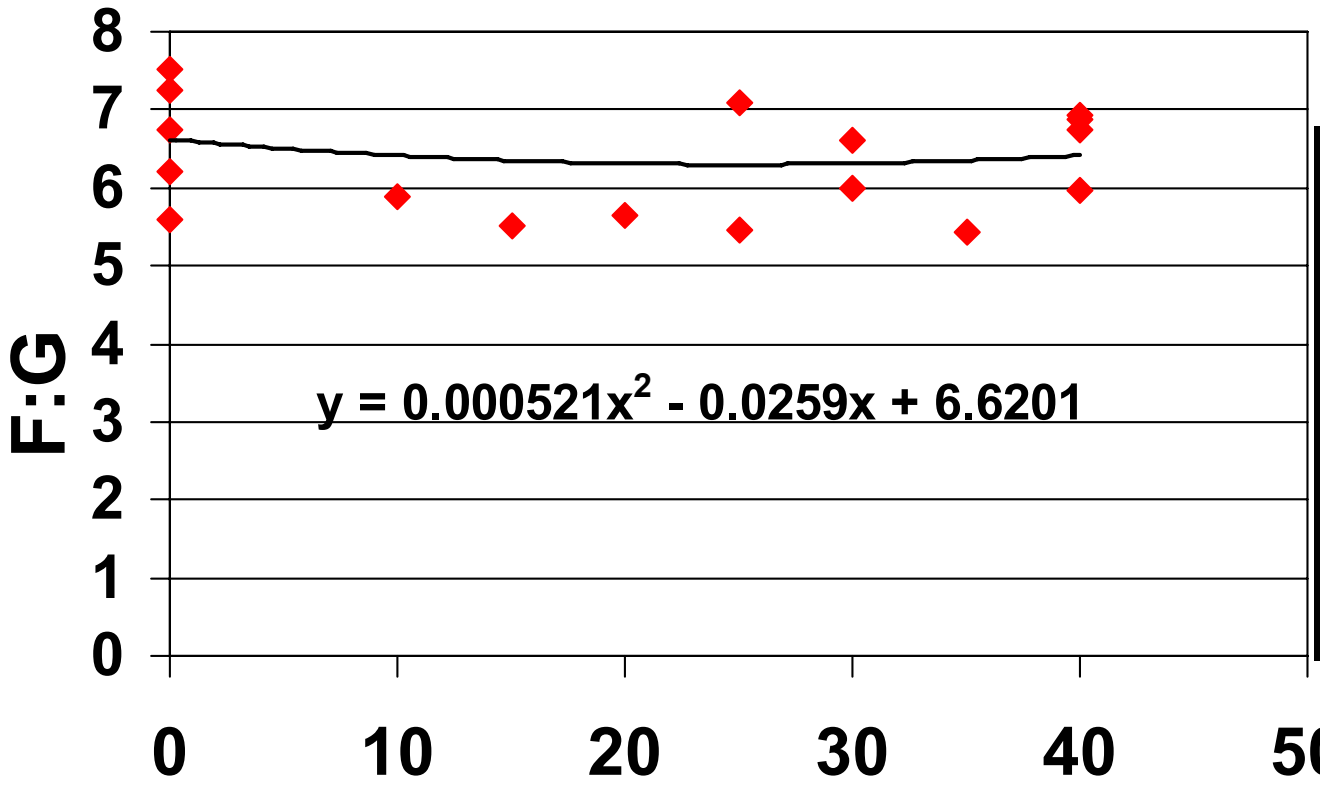
Average Daily Gain



Predicted Values	
DDGS Level	ADG (lb)
0	3.43
10	3.63
20	3.73
30	3.74
40	3.65

Linear P < 0.01
Quadratic P < 0.01
Cubic P = 0.54

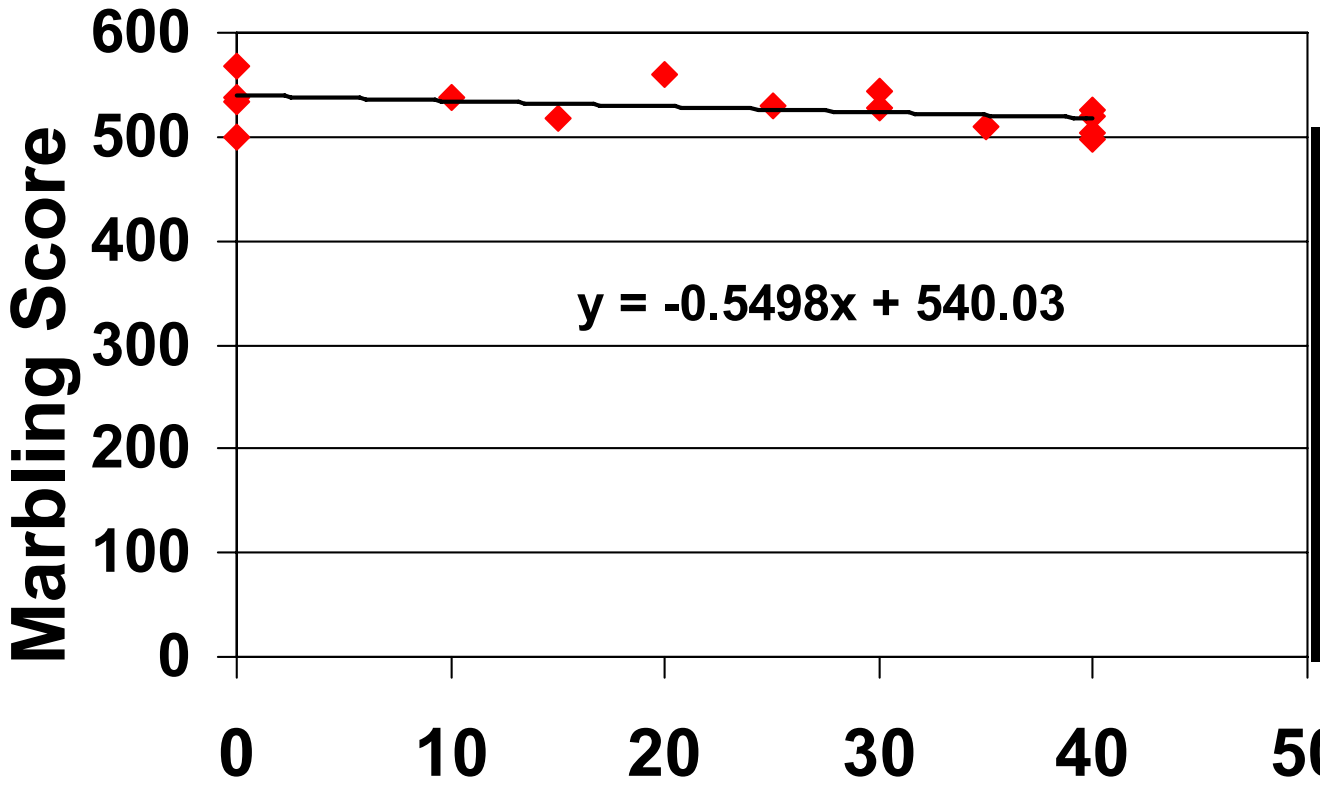
Feed Conversion



Predicted Values	
DDGS Level	F:G
0	6.62
10	6.41
20	6.31
30	6.31
40	6.42

Linear P = 0.07
Quadratic P = 0.02
Cubic P = 0.97

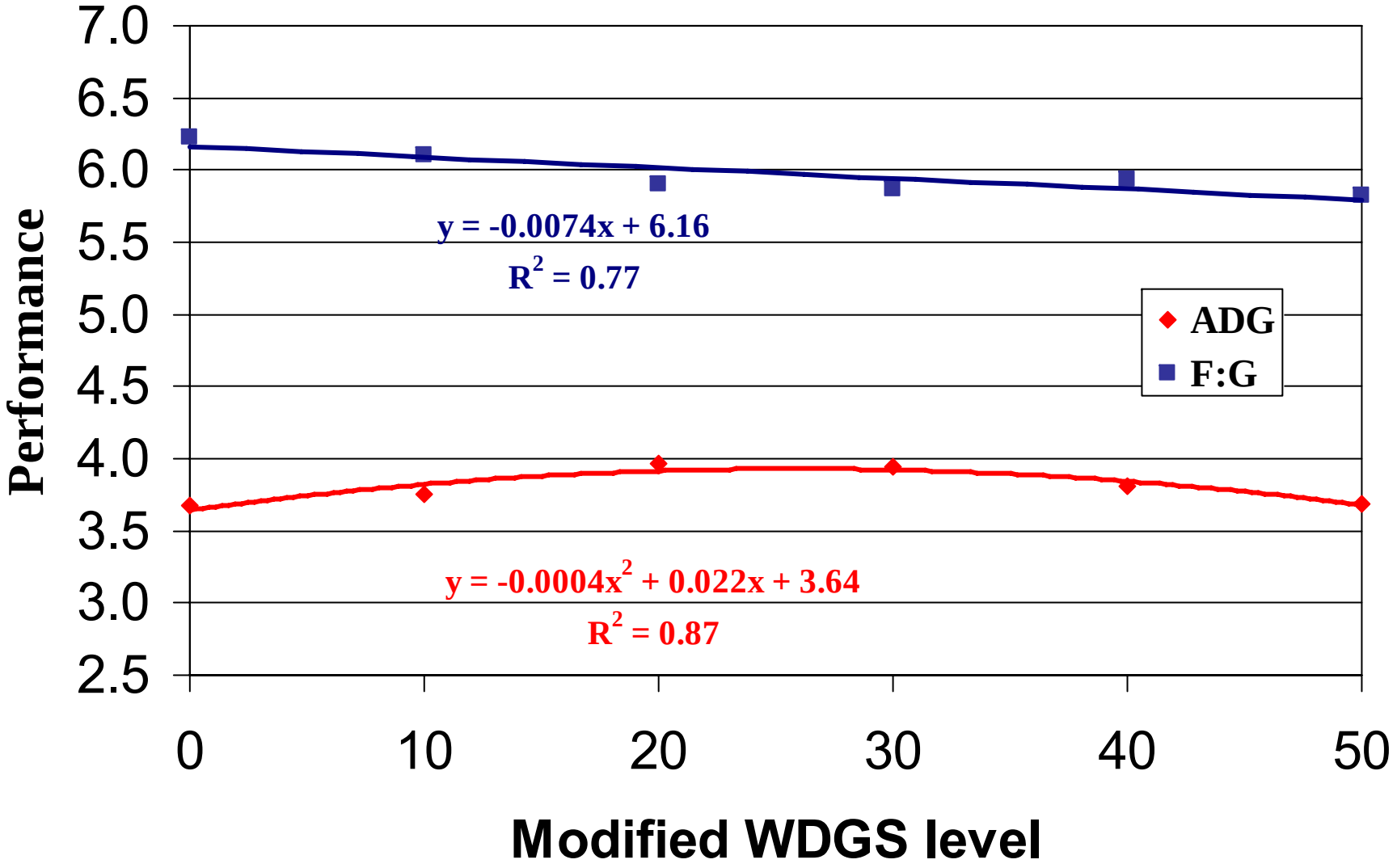
Marbling Score



Predicted Values	
DDGS Level	Marbling
0	540
10	535
20	529
30	524
40	518

Linear P = 0.07
Quadratic P = 0.13
Cubic P = 0.79

Modified WDGS

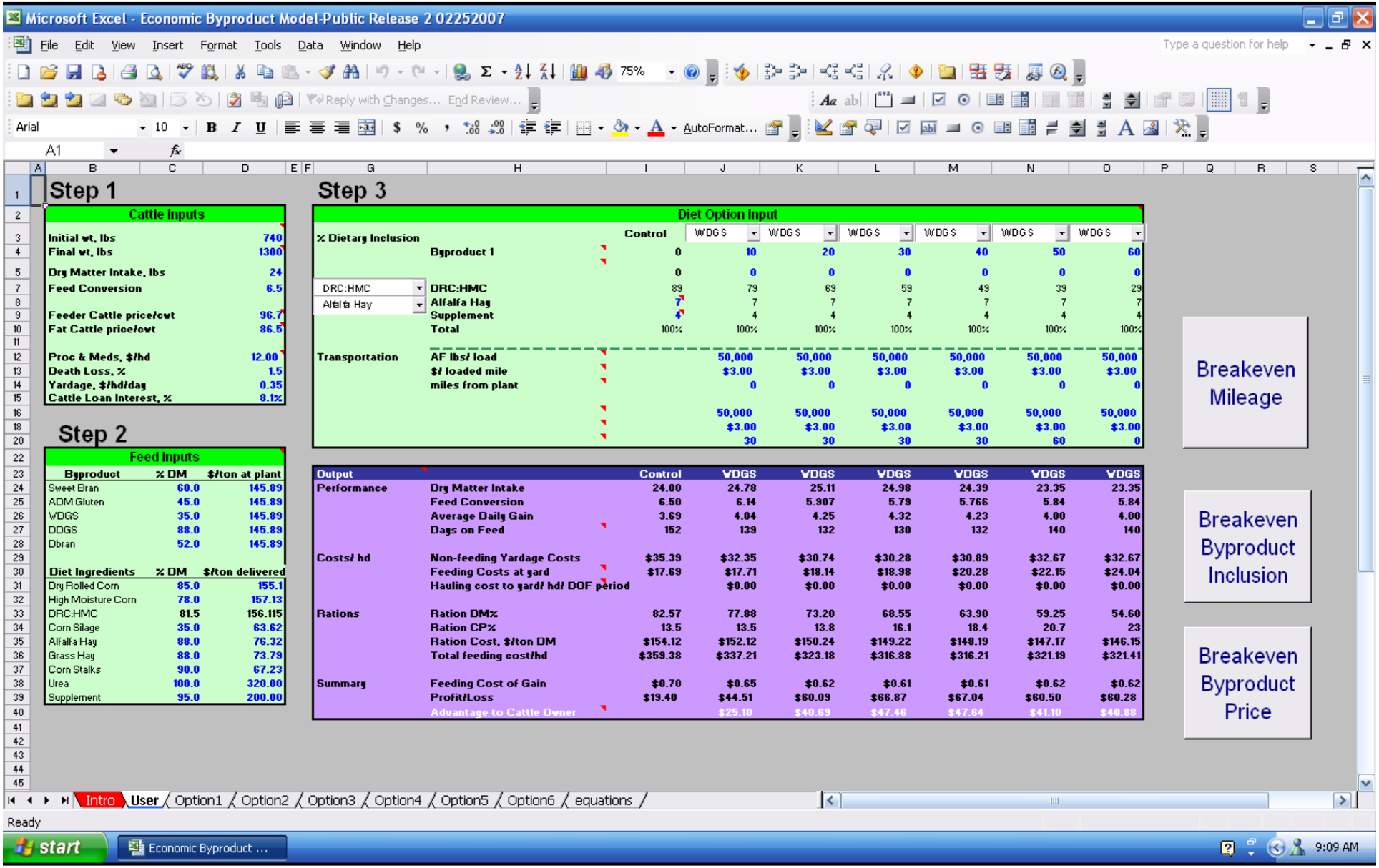


Huls et al., 2008 Nebraska Beef Rep. (in press)

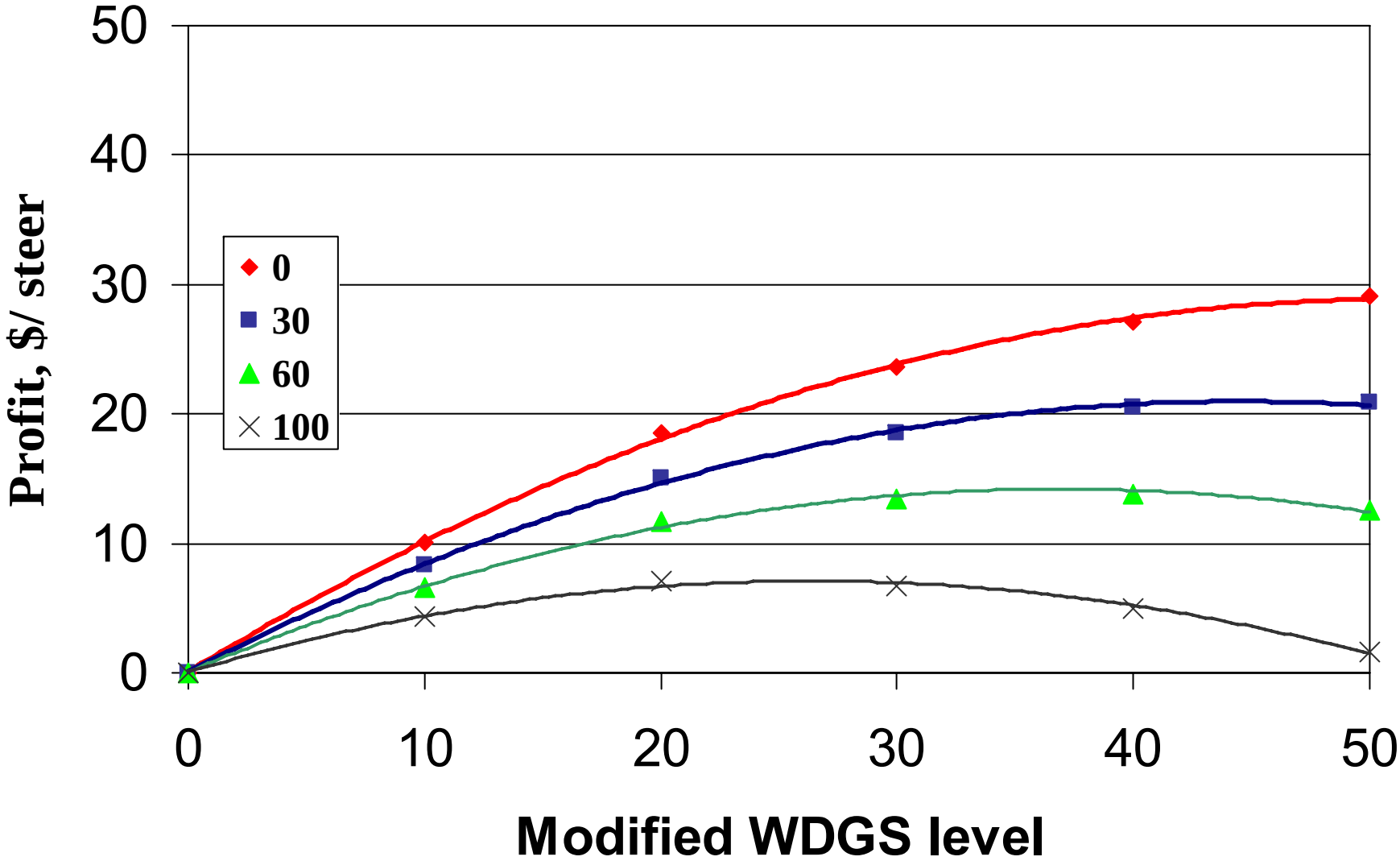
Feeding Value Results

	Diet % DGS (DM basis)					
	0	10	20	30	40	50
DDGS FV, % of corn	100	153	123	107	100	
MDGS FV, % of corn	100	123	127	118	109	111
WDGS FV, % of corn	100	145	142	137	131	126

Feeding Value =((DGS G:F/CON G:F)-1)/(DGS inclusion decimal))+100

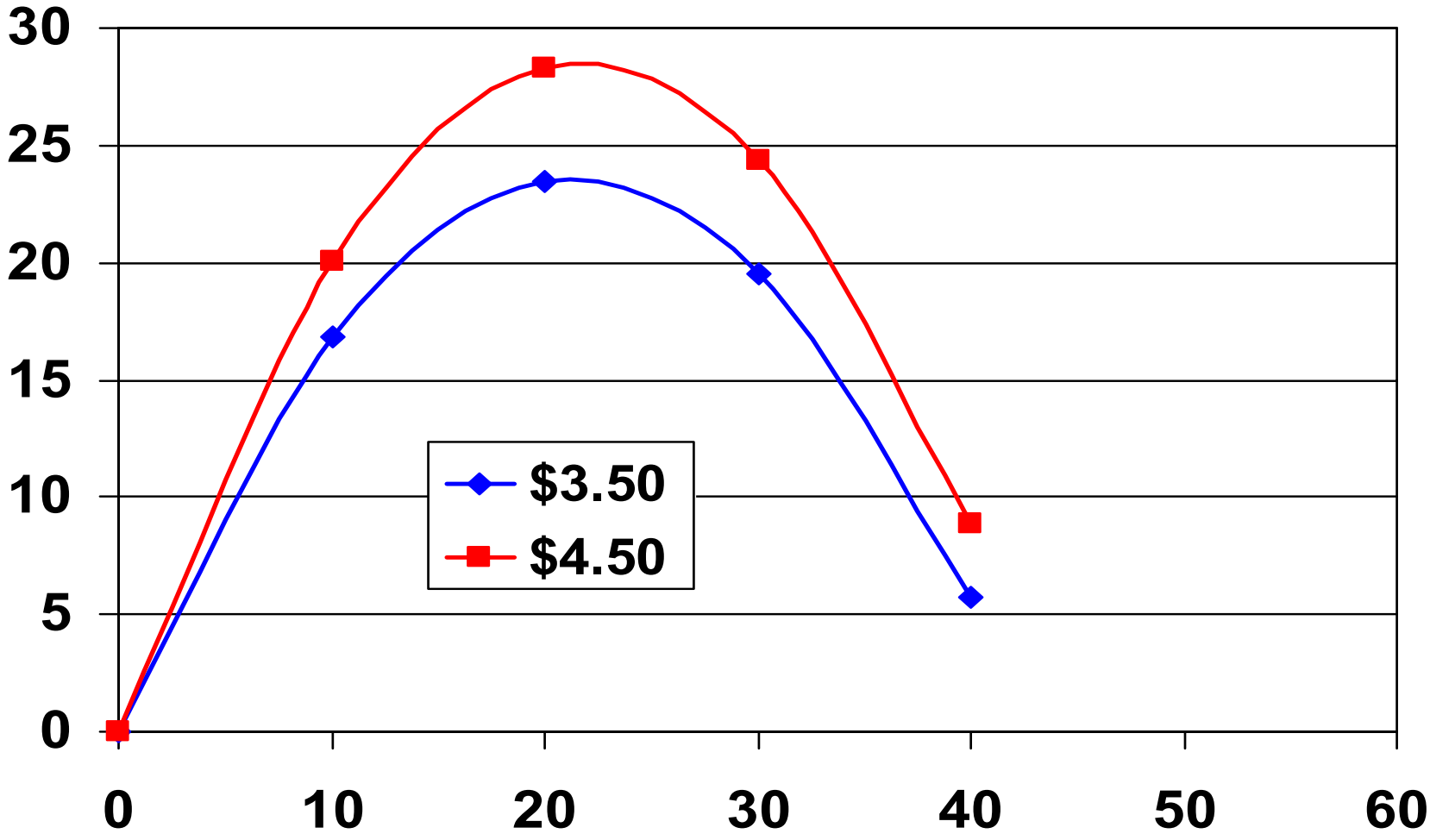

Microsoft Excel - Economic Byproduct Model-Public Release 2 02252007
Step 1
Cattle Inputs
Initial wt, lbs 740
Final wt, lbs 1300
Dry Matter Intake, lbs 24
Feed Conversion 6.5
Feeder Cattle price/cwt 96.7
Fat Cattle price/cwt 86.5
Proc & Meds, $/hd 12.00
Death Loss, % 1.5
Yardage, $/hd/day 0.35
Cattle Loan Interest, % 8.1%
Step 2
Feed Inputs
Byproduct % DM $/ton at plant
Sweet Bran 60.0 145.89
ADM Gluten 45.0 145.89
WDGS 35.0 145.89
DDGS 88.0 145.89
Dbran 52.0 145.89
Diet Ingredients % DM $/ton delivered
Dry Rolled Corn 85.0 155.1
High Moisture Corn 78.0 157.13
DRC:HMC 81.5 156.115
Corn Silage 35.0 63.62
Alfalfa Hay 88.0 76.32
Grass Hay 88.0 73.79
Corn Stalks 90.0 67.23
Urea 100.0 320.00
Supplement 95.0 200.00
Step 3
Diet Option Input
% Dietary Inclusion
Control
WDGS
Byproduct 1 0 10 20 30 40 50 60
0 0 0 0 0 0 0
DRC:HMC 89 79 69 59 49 39 29
Alfalfa Hay 7 7 7 7 7 7 7
Supplement 4 4 4 4 4 4 4
Total 100% 100% 100% 100% 100% 100% 100%
Transportation
AF lbs/ load 50,000 50,000 50,000 50,000 50,000 50,000
$/ loaded mile $3.00 $3.00 $3.00 $3.00 $3.00 $3.00
miles from plant 0 0 0 0 0 0
50,000 50,000 50,000 50,000 50,000 50,000
$3.00 $3.00 $3.00 $3.00 $3.00 $3.00
30 30 30 30 60 0
Output Control VDGS VDGS VDGS VDGS VDGS VDGS
Performance
Dry Matter Intake 24.00 24.78 25.11 24.98 24.39 23.35 23.35
Feed Conversion 6.50 6.14 5.907 5.79 5.766 5.84 5.84
Average Daily Gain 3.69 4.04 4.25 4.32 4.23 4.00 4.00
Days on Feed 152 139 132 130 132 140 140
Costs/ hd
Non-feeding Yardage Costs $35.39 $32.35 $30.74 $30.28 $30.89 $32.67 $32.67
Feeding Costs at yard $17.69 $17.71 $18.14 $18.98 $20.28 $22.15 $24.04
Hauling cost to yard/ hd/ DOF period $0.00 $0.00 $0.00 $0.00 $0.00 $0.00
Rations
Ration DM% 82.57 77.88 73.20 68.55 63.90 59.25 54.60
Ration CP% 13.5 13.5 13.8 16.1 18.4 20.7 23
Ration Cost, $/ton DM $154.12 $152.12 $150.24 $149.22 $148.19 $147.17 $146.15
Total feeding cost/hd $359.38 $337.21 $323.18 $316.88 $316.21 $321.19 $321.41
Summary
Feeding Cost of Gain $0.70 $0.65 $0.62 $0.61 $0.61 $0.62 $0.62
Profit/Loss $19.40 $44.51 $60.09 $66.87 $67.04 $60.50 $60.28
Advantage to Cattle Owner $25.10 $40.69 $47.46 $47.64 $41.10 $40.88
Breakeven Mileage
Breakeven Byproduct Inclusion
Breakeven Byproduct Price
Intro User Option1 Option2 Option3 Option4 Option5 Option6 equations
Ready
start
Economic Byproduct ...
9:09 AM

Modified WDGS - $

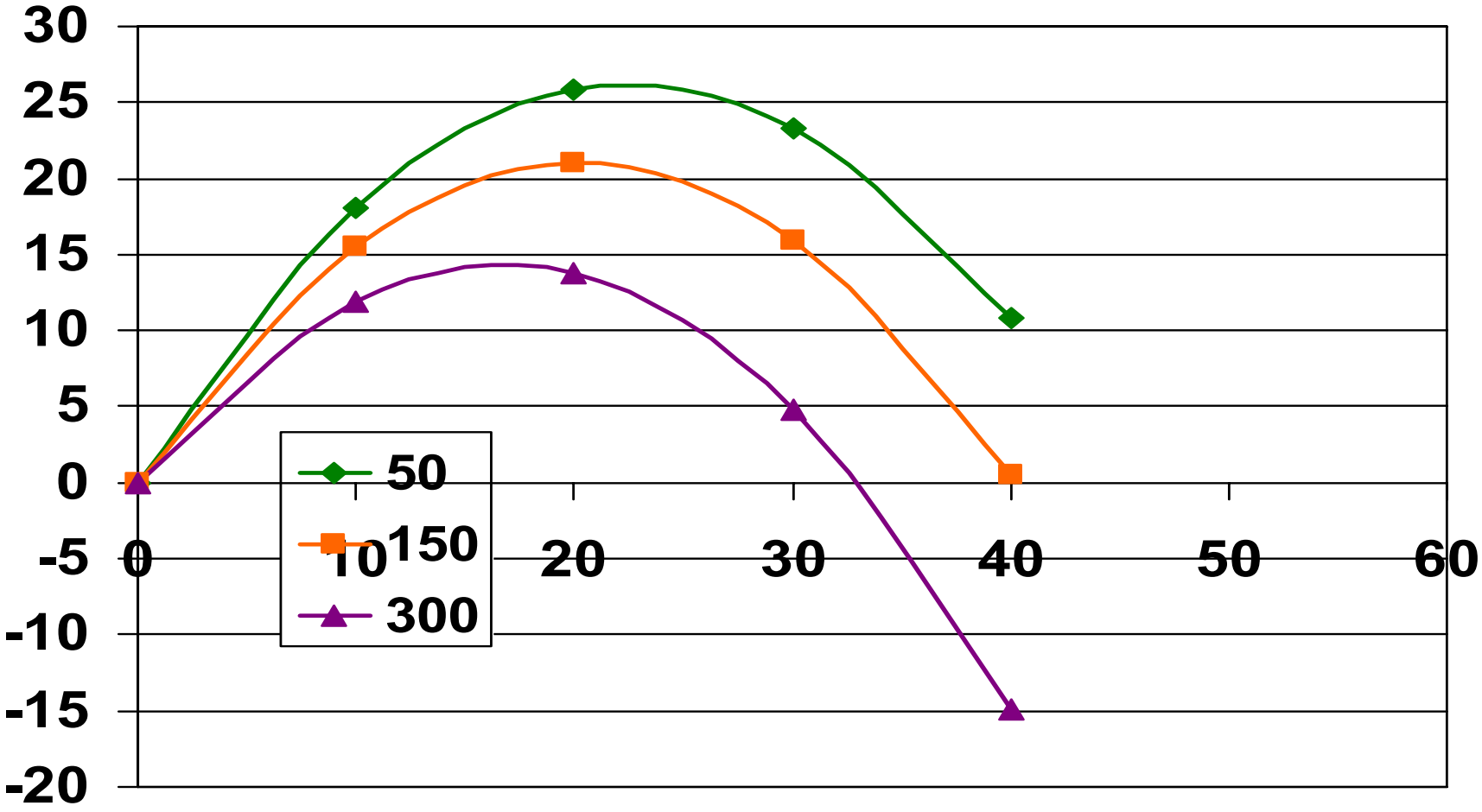


Huls et al., 2008 Nebraska Beef Rep. (in press)

Corn Price with DDGS



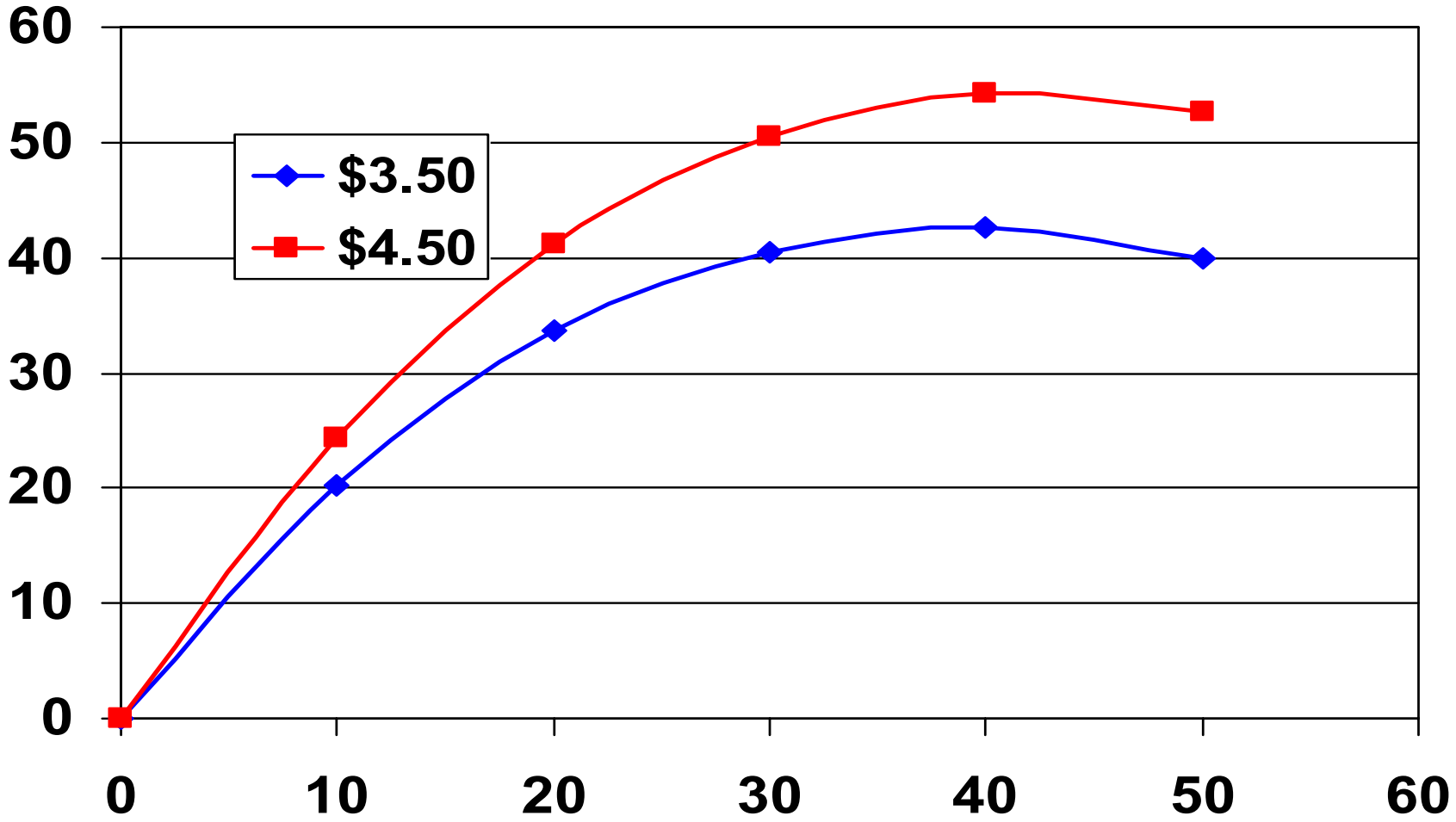
Mileage with DDGS



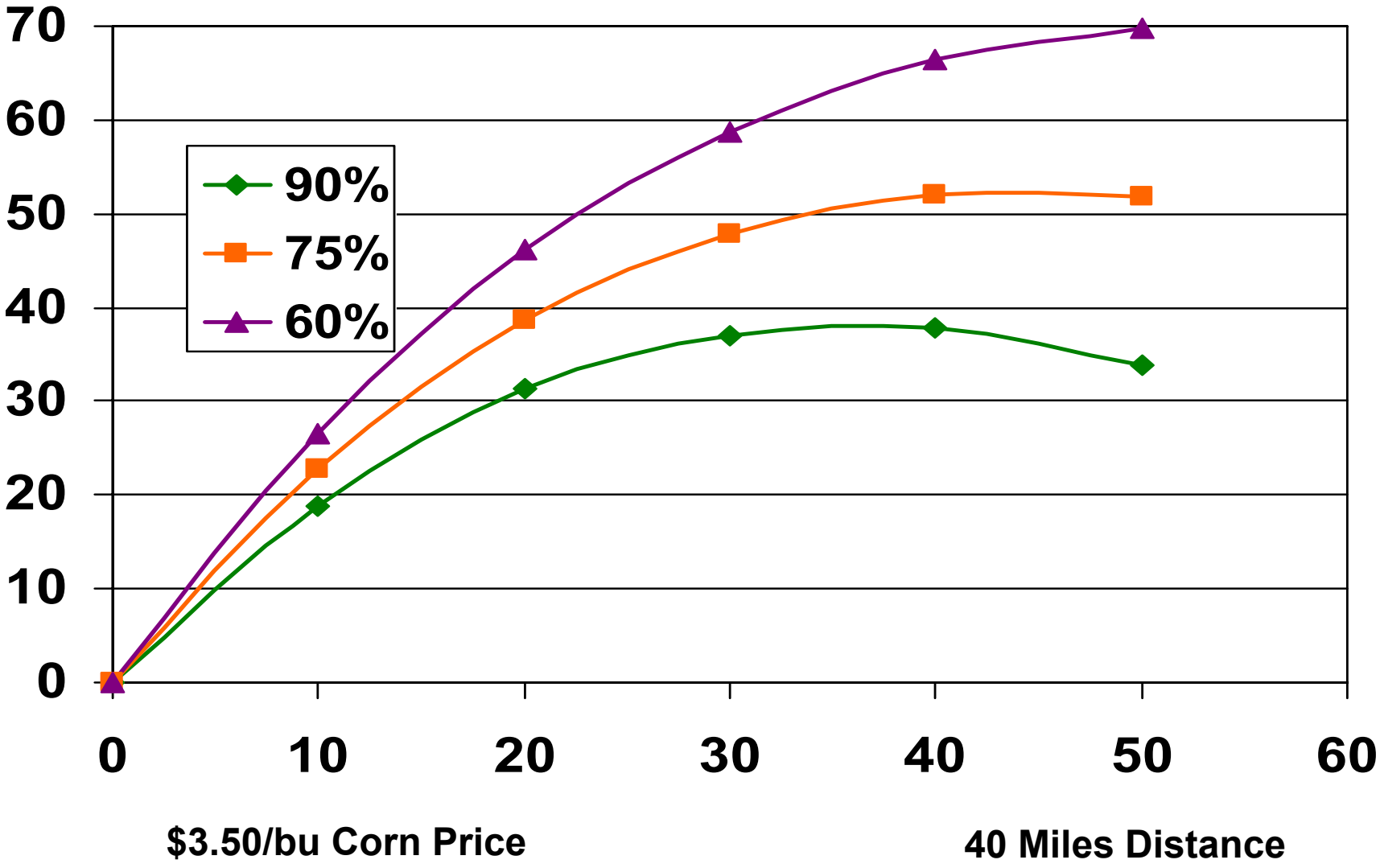
85% DDGS Price to Corn

$3.50 Corn Price

Corn Price with WDGS



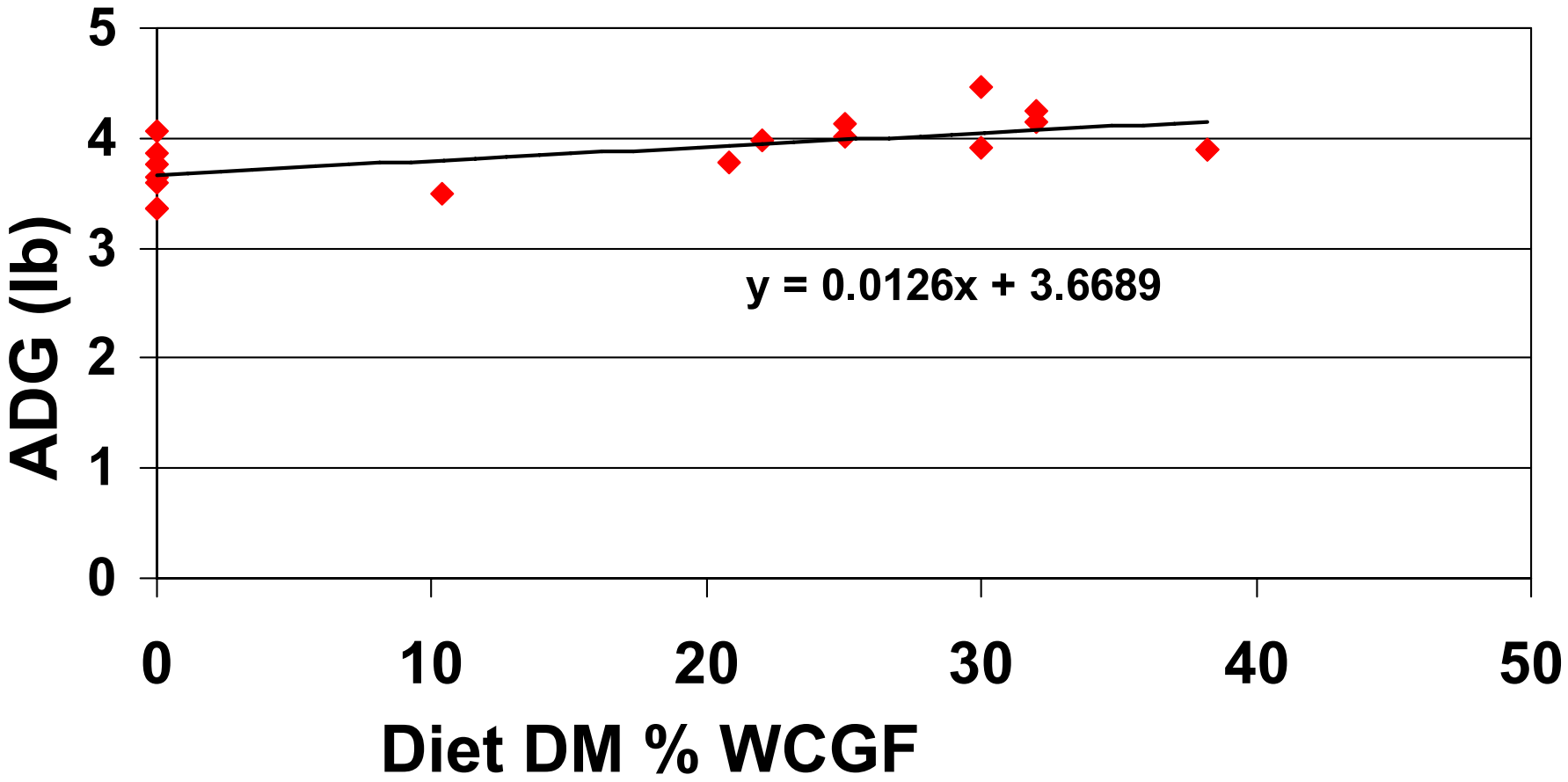
WDGS Price to Corn



UNL Studies Used

Experiment	Year	Diet DM % Sweet Bran	Hd/Tx
Richards et al.	1993	0, 25	40
Scott et al.	1995	0, 10, 21, 38	40
Herold et al.	1996	0, 38	40
Scott et al.	1999	0, 32	60
Scott et al.	1999	0, 22	48
Buckner et al.	2005	0, 30	50
Losa et al.	2005	0, 30	72

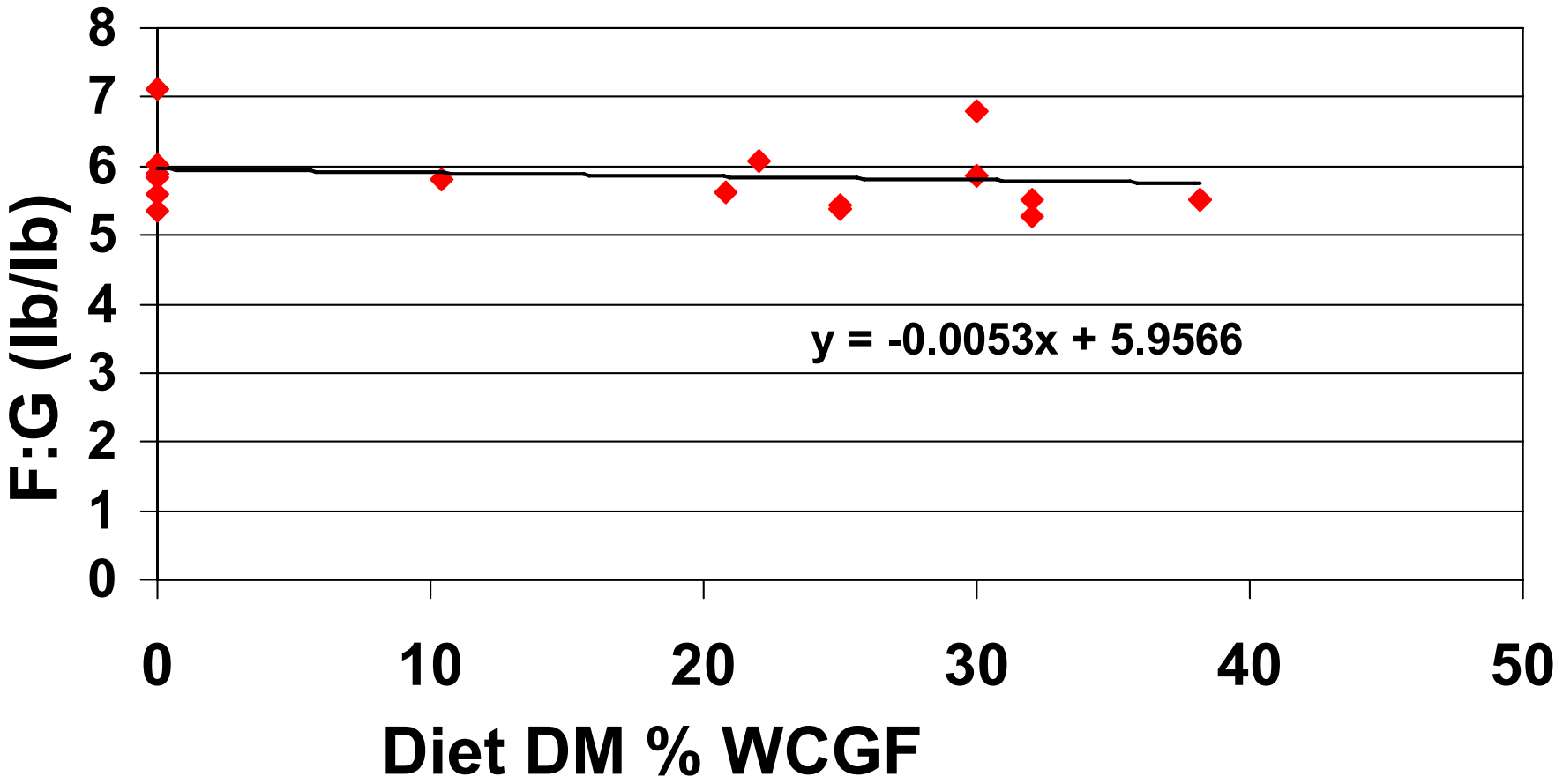
Average Daily Gain



Intercept
cov. P = 0.05
≠ 0 P < 0.01

L P < 0.01
Q P = 0.67

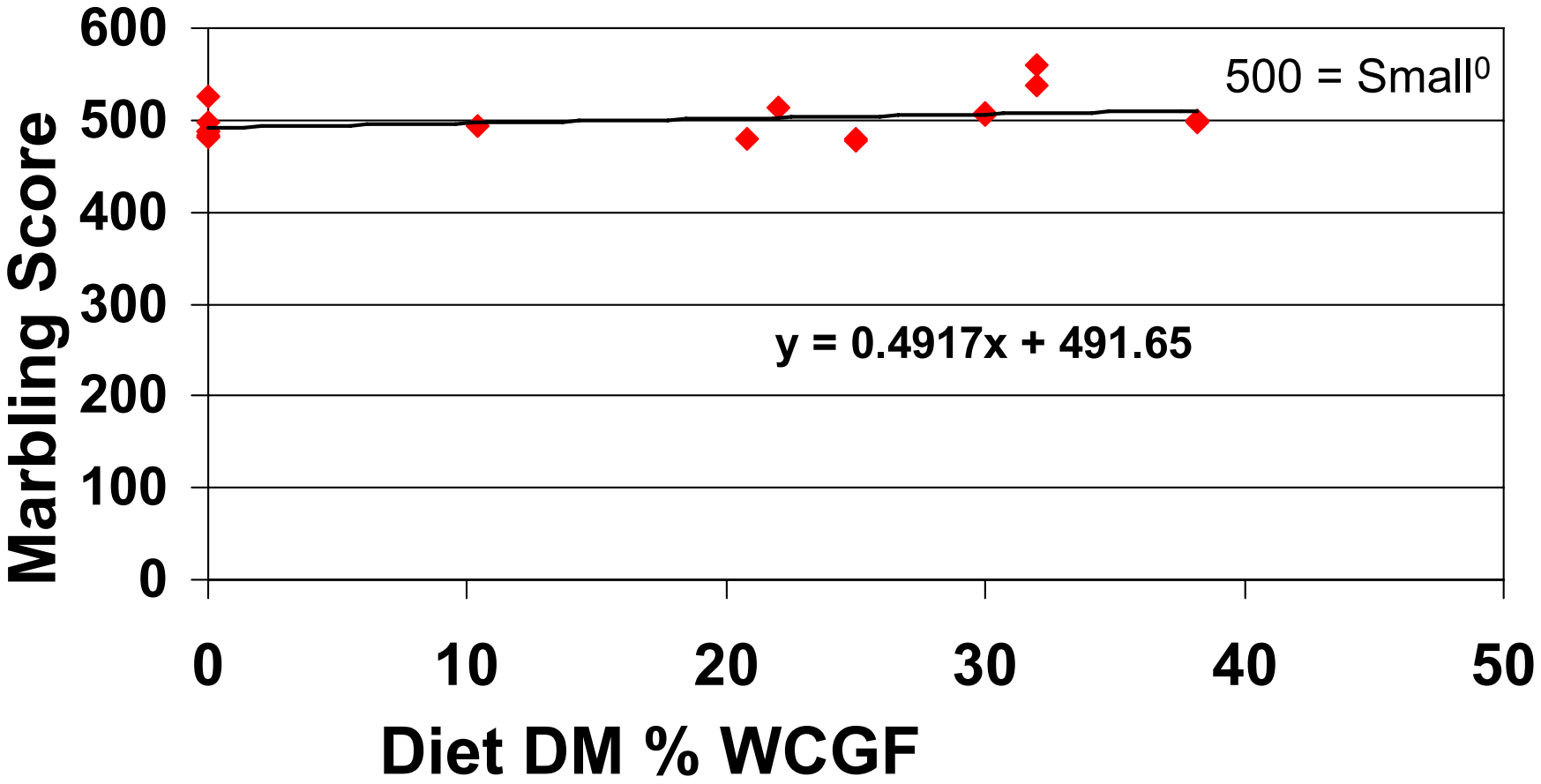
Feed Conversion



Intercept
cov. P = 0.05
≠ 0 P < 0.01

L P = 0.03
Q P = 0.48

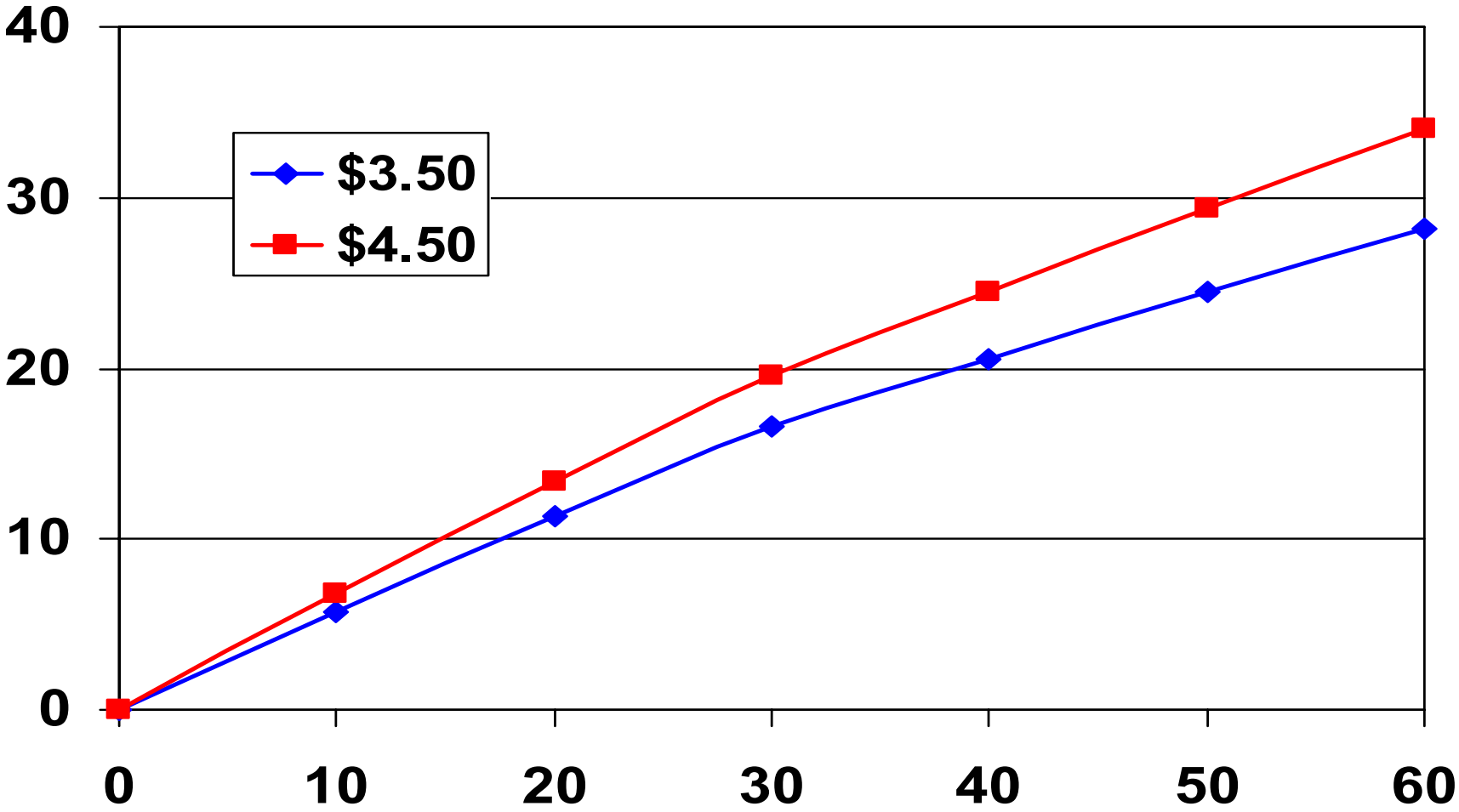
Marbling Score



Intercept
cov. P = 0.06
≠ 0 P < 0.01

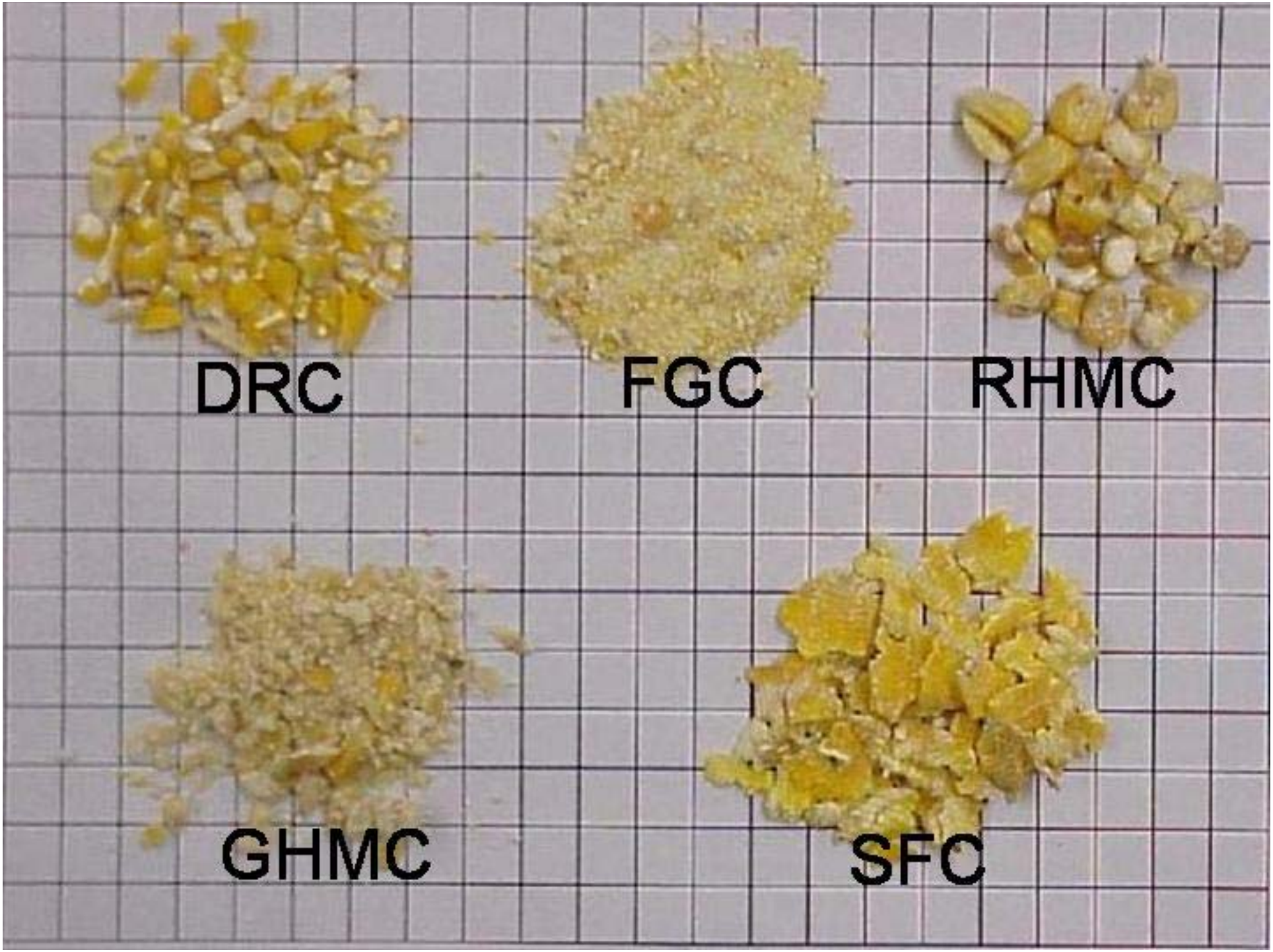
L P < 0.01
Q P = 0.78

Corn Price with Sweet Bran



Feedlot Diet Issues for DGS

- Roughages
- Corn processing
- Rumensin & Tylan
- Feeding greater amounts
- Sulfur
- Phosphorus
- Storage


DRC
FGC
RHMC
GHMC
SFC

WCGF & Grain Processing

	DRC	RHMC	GHMC	SFC
DMI	23.2[a]	21.6[b]	21.4[b]	21.3[b]
ADG	4.23	4.21	4.24	4.33
F:G	5.49[a]	5.13[c]	5.05[c]	4.91[d]
Corn:	--	10.9	13.4	17.6

All diets contained 25% WCGF, 60% of respective corn
Calves fed 152 days, initial weight = 677 lb

Macken et al., 2006 Prof. Anim. Scient.

WCGF & Grain Processing

	DRC	HMC	SFC
		without WCGF	
Improved, % above DRC	--	1.4	11.4
		with WCGF	
Improved, % above DRC	--	8.1	14.6

Note: DRC is 13.2% better than whole (1 comparison)

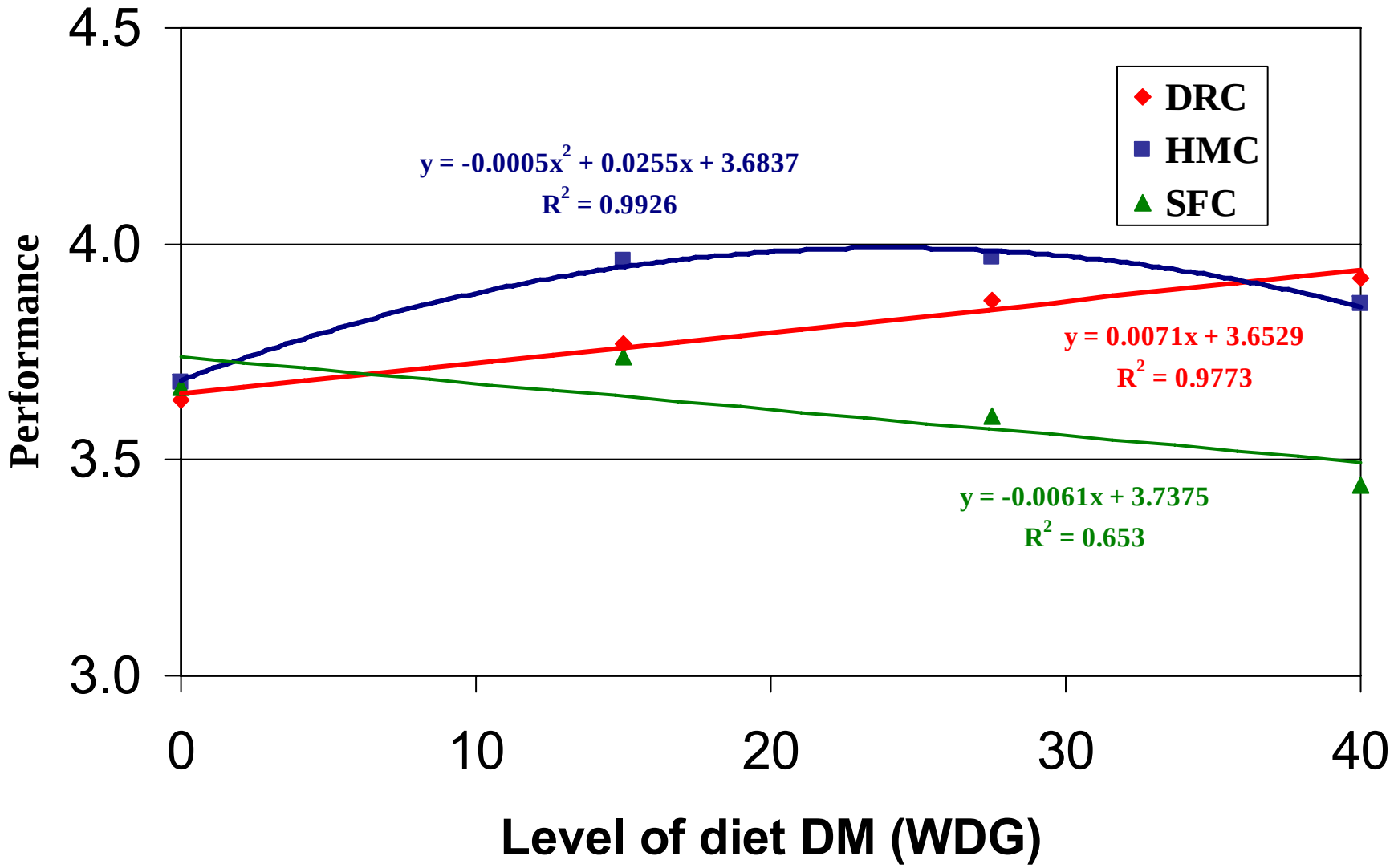
WDGS & Grain Processing

	WC	DRC	HMC	SFC
DMI	23.1^{a}	22.6^{a}	21.0^{bc}	20.4^{c}
ADG	3.85^{a}	4.05^{b}	3.89^{ab}	3.59^{c}
F:G	6.07^{a}	5.68^{bc}	5.46^{c}	5.76^{b}
Corn:	-11.2	--	6.3	-2.3

All diets contained 30% WDGS; 61.4% corn
Calf-feds 168 days, initial weight = 700 lb

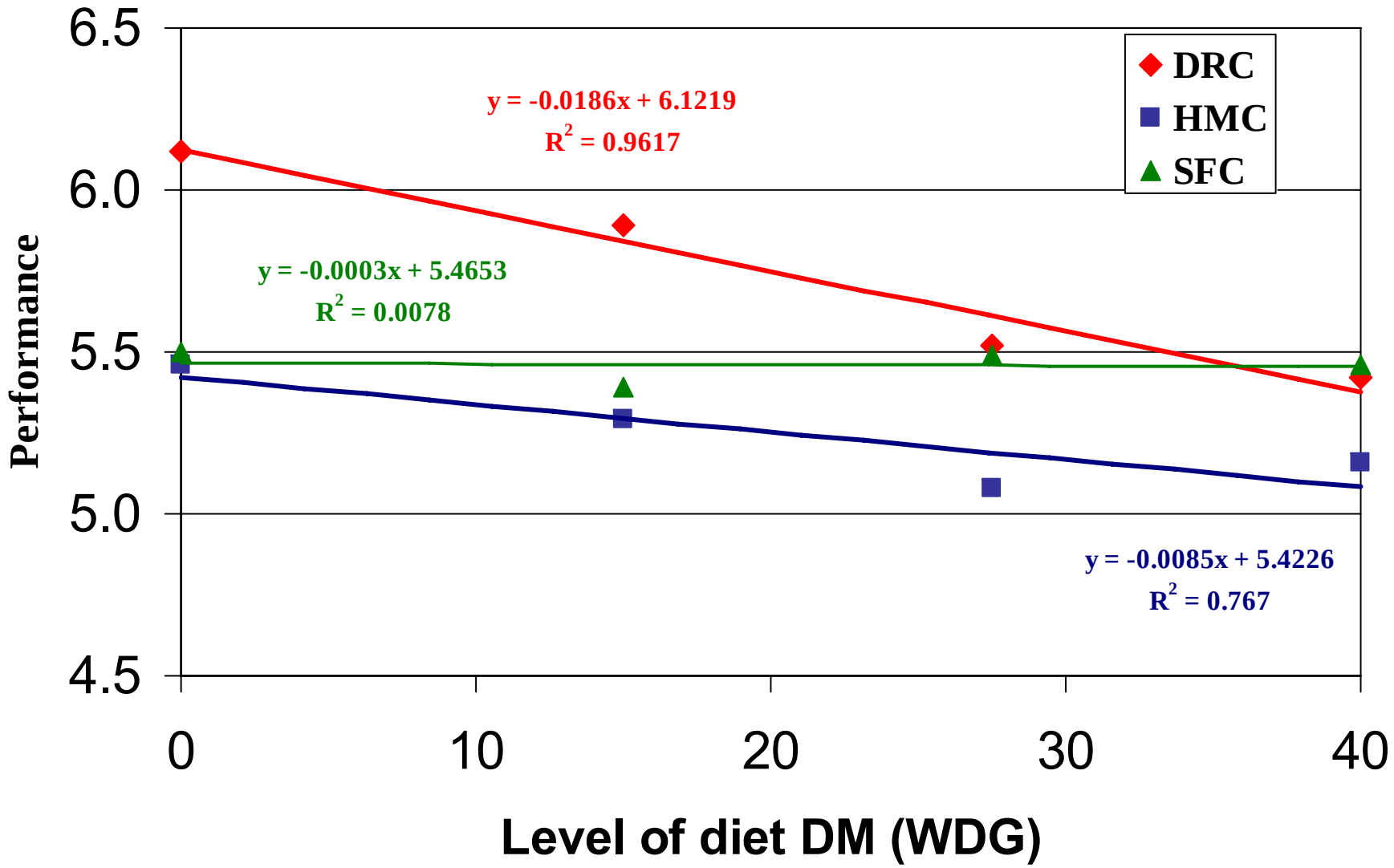
Vander Pol et al., 2006 Nebraska Beef Rep.

WDGS & Grain Processing



Corrigan et al., 2007 Nebraska Beef Rep.

WDGS & Grain Processing



Corrigan et al., 2007 Nebraska Beef Rep.

Effects of Roughage Level in WDGS Diets

	Treatments			P-Value
	CONTROL	**½ Normal**	**Normal**	**Level**
Level (%DM)	0	3-6	6-12	---
DMI	22.3[a]	24.6[b]	25.6[c]	<0.01
ADG	4.33[a]	4.62[b]	4.77[c]	<0.01
F:G	5.13[a]	5.32[b]	5.35[b]	0.03
P/L, $	0.00[a]	16.34[ab]	26.56[b]	0.02

Benton et al., 2007 Nebraska Beef Rep.

Effects of Roughages in WDGS Diets

	Treatments			
	½ Normal Corn Stalks	Normal Alfalfa	Normal Corn Silage	Normal Corn Stalks
Level (%DM)	3.04	8.00	12.26	6.08
DMI	25.0	25.7	25.3	25.6
ADG	4.79	4.76	4.75	4.80
F:G	5.21	5.41	5.32	5.32
P/L, $	30.90	22.84	27.25	29.58

Benton et al., 2007 Nebraska Beef Rep.

WDGS and Rum/Tylan

	CON+33RT	DG	DG+33R	DG+33RT	DG+44RT
DMI	23.5	23.9	23.6	23.4	23.0
ADG	3.72[a]	3.87[b]	3.93[b]	3.97[b]	3.87[b]
F:G	6.31[a]	6.16[b]	6.01[c]	5.89[c]	5.96[c]

All DG diets contained 30% WDGS;
Rumensin at either 0, 33, or 44 g/ton DM;
Tylan at either 0 or 90 mg/steer daily.

20 steers per pen; 40 pens; 8 pens per treatment

Meyer et al., 2008; unpublished National ASAS abstract, PNC meeting

WDGS and Rum/Tylan

	CON+33RT	DG	DG+33R	DG+33RT	DG+44RT
DMI	23.5^{abc}	23.9^{a}	23.6^{ab}	23.4^{bc}	23.0^{c}
ADG	3.72^{a}	3.87^{b}	3.93^{b}	3.97^{b}	3.87^{b}
F:G	6.31^{a}	6.16^{b}	6.01^{c}	5.89^{c}	5.96^{c}

WDGS is 22% better than corn, 6.7% better for diet

2.4% improvement for Rumensin alone in WDGS diets
4.4% improvement for Rumensin and Tylan in WDGS diets

Meyer et al., 2008; unpublished National ASAS abstract, PNC meeting

WDGS and Rum/Tylan

	CON+33RT	DG	DG+33R	DG+33RT	DG+44RT
Total	17.0[a]	42.4[b]	40.8[b]	8.3[a]	8.9[a]
A+	4.4[a]	16.5[b]	19.1[b]	3.8[a]	7.0[a]

Liver abscess % based on 156-159 out of 160 steers tested

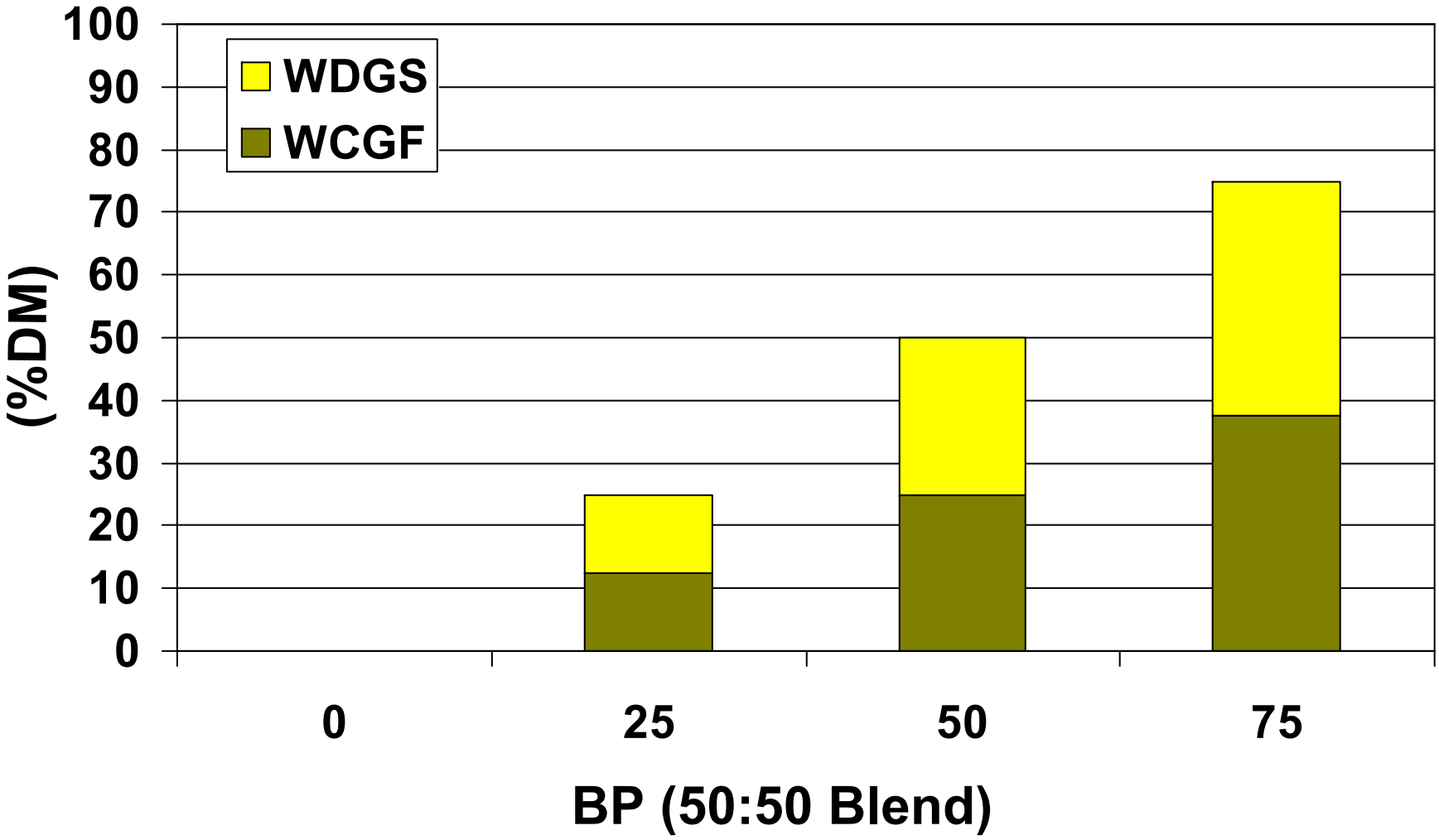
All DG diets contained 30% WDGS;
Rumensin at either 0, 33, or 44 g/ton DM;
Tylan at either 0 or 90 mg/steer daily.

20 steers per pen; 40 pens; 8 pens per treatment

Meyer et al., 2008; unpublished National ASAS abstract, PNC meeting

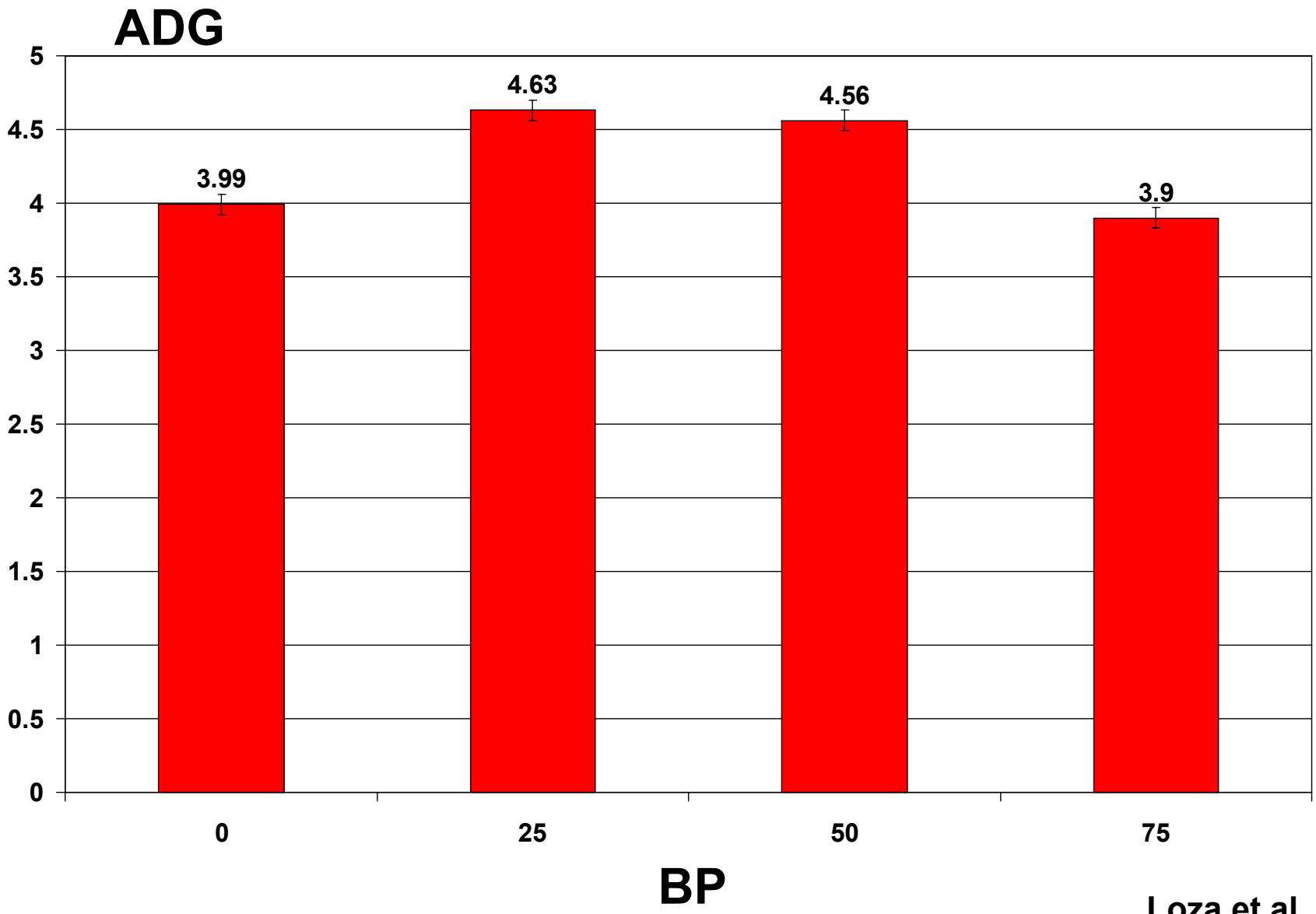
Do we have to feed grain?

WCGF/WDGS combination



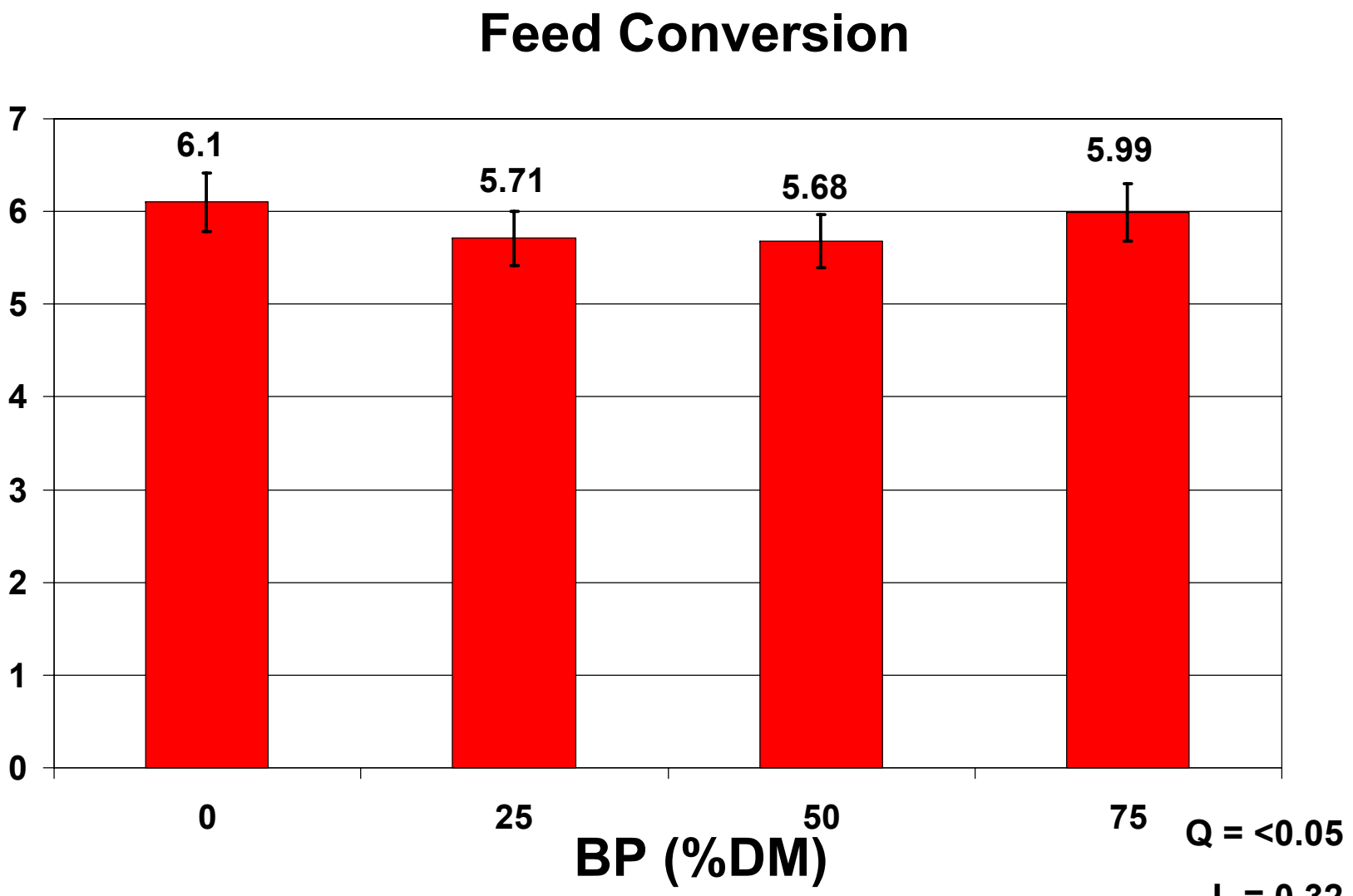
Loza et al., 2003

WCGF/WDGS combination



Loza et al., 2003

WCGF/WDGS combination



Loza et al., 2003

Sulfur/Polio

- 4143 finished cattle
- 24 “pulled” as “brainers”
- 12 on .47% sulfur, no roughage

Sulfur/Polio

- NRC .40% S
- < 20% byproduct, 0.1% “pulls”
- < 0.47% S, 0.14% “pulls”
- 0.47% to 0.58% S, 0.38% “pulls”
- >0.58% S, 6.06% “pulls”

Sulfur/Polio Recommendations

- < 0.48% S – low risk
- 50% WDGS ≈ 0.47% suflur
- Know levels in byproducts
- Water S?
- Maintain roughage?

Calculating S intake from H_2O

- Cattle consume (assume)
  - ~ 8.5-9.0 gallons/d (summer)
  - ~ 4.5-5.0 gallons/d (winter)
  - 24.2 lb intake (DM) = 11 kg
  - 8.34 lb/gallon, 3.785 L(kg)/gallon; 1 L = 1 kg,
- if H_2O: 100 ppm sulfur = 100 mg/kg (mg/kg = ppm)
- 0.1 g/kg sulfur, consuming 34 kg of water (9 gallons)
  - therefore, 3.4 g from water
  - if consuming 11 kg feed at 0.3% sulfur = 33 g
  - additional 3.4 g increases diet S to 0.33%
  - 500 ppm sulfur (mg/L or mg/kg) = 17 g from water

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Higher DGS

TRT:	83% corn	44DG: -corn	66DG: -hay	44DG: 44GF	33DG: 33GF -corn	33DG: 33GF -hulls
Corn	82.5	43.8	-	-	21.9	-
WDGS	-	43.8	65.6	43.8	32.8	32.8
WCGF	-	-	-	43.8	32.8	32.8
Soyhulls	-	-	-	-	-	21.9
Grass	-	-	21.9	-	-	-
Molasses	5.0	-	-	-	-	-
Alfalfa	7.5	7.5	7.5	7.5	7.5	7.5
Supplement	5.0	5.0	5.0	5.0	5.0	5.0

Higher DGS

TRT:	83% corn	44DG: -corn	66DG: -hay	44DG: 44GF	33DG: 33GF -corn	33DG: 33GF -hulls
DMI	26.1	25.2	26.6	24.8	26.1	25.8
ADG	4.03	4.47	4.03	3.97	4.16	3.73
F:G	6.45^{bc}	5.62^{a}	6.62^{c}	6.25^{b}	6.29^{b}	6.94^{d}

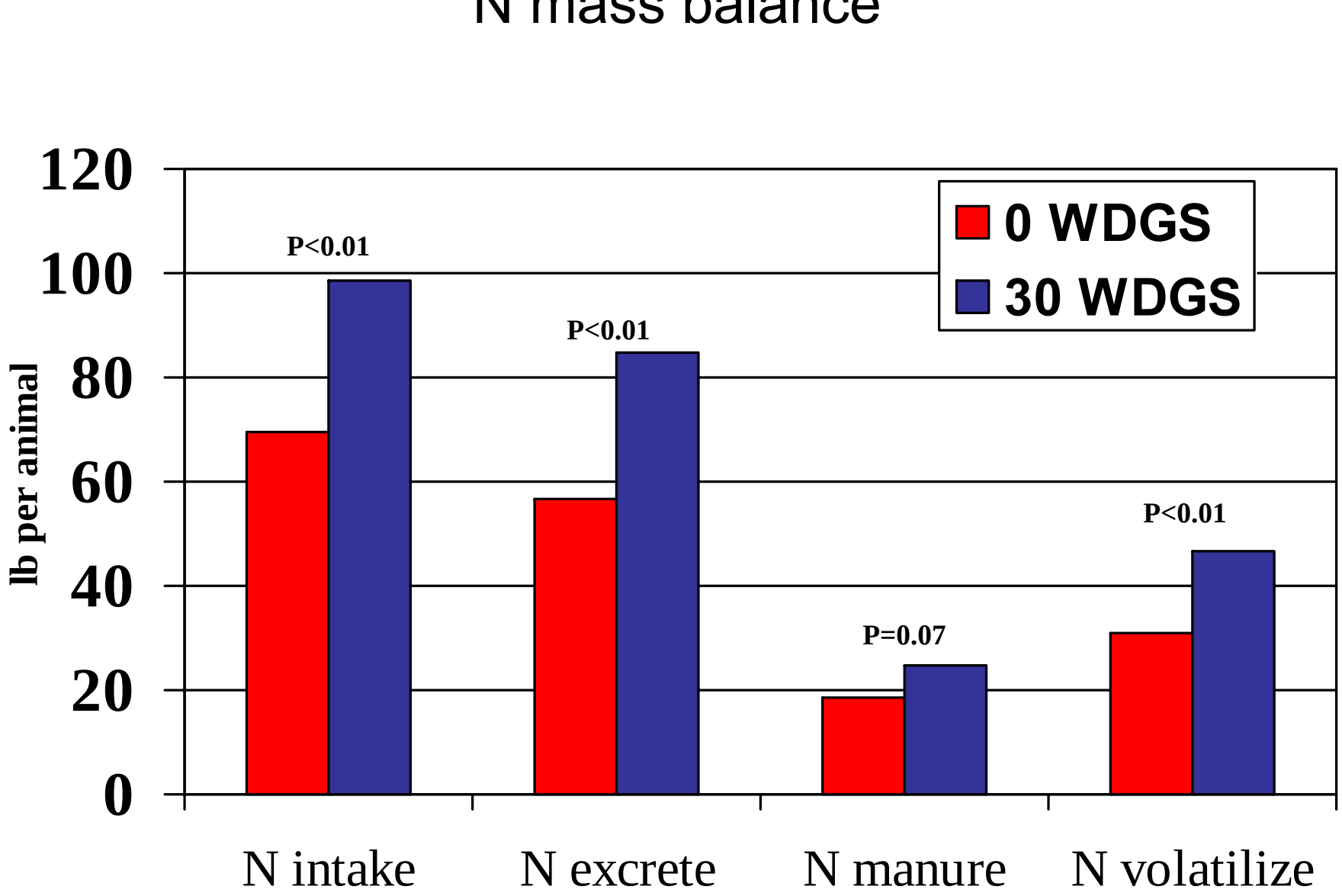
P = 0.06 for WDG-hay and soyhulls

N issues

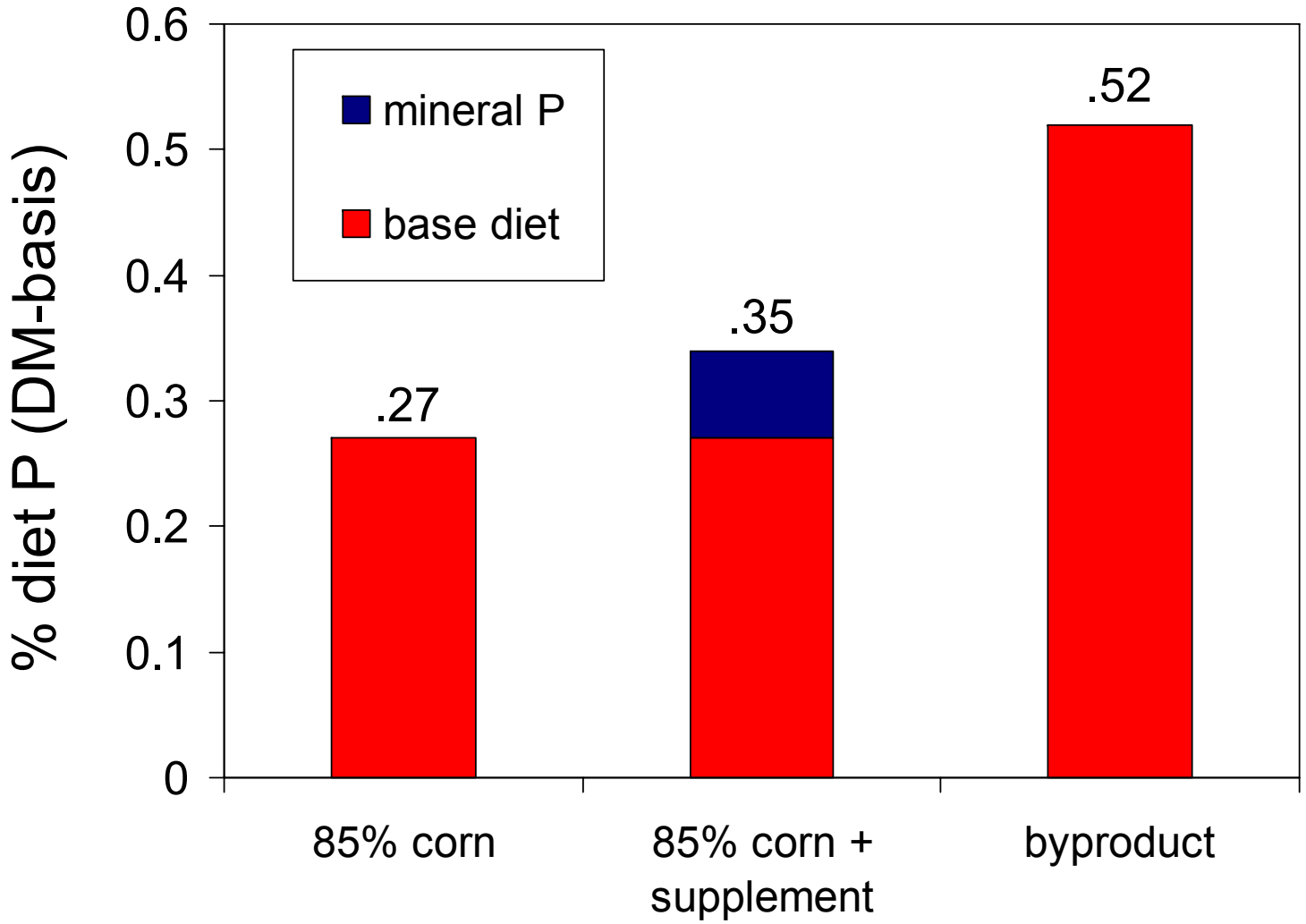
&

PHOSPHORUS

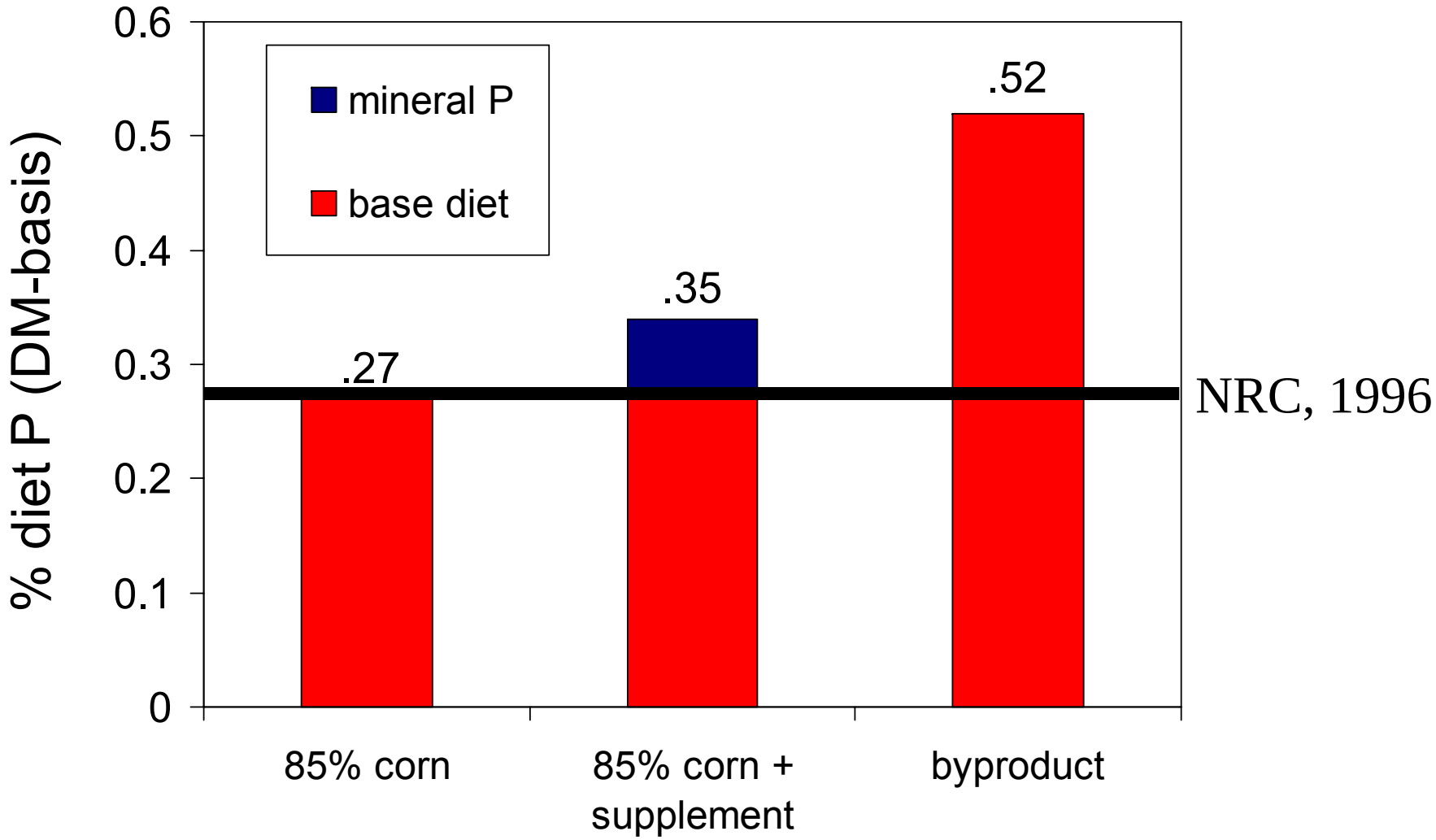
Impact of DGS on N challenge



Dietary P in Feedlot Diets



Dietary P in Feedlot Diets



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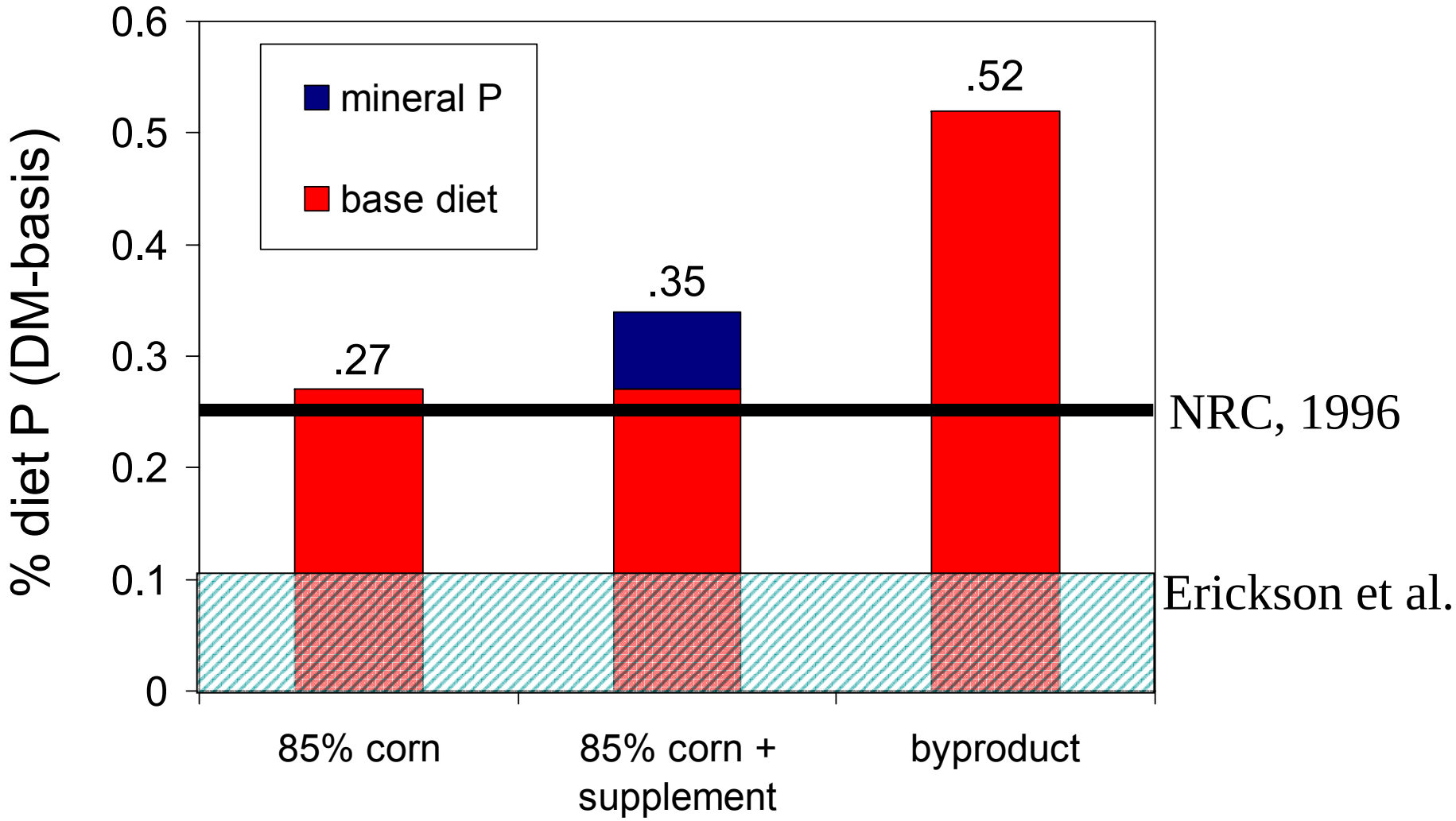
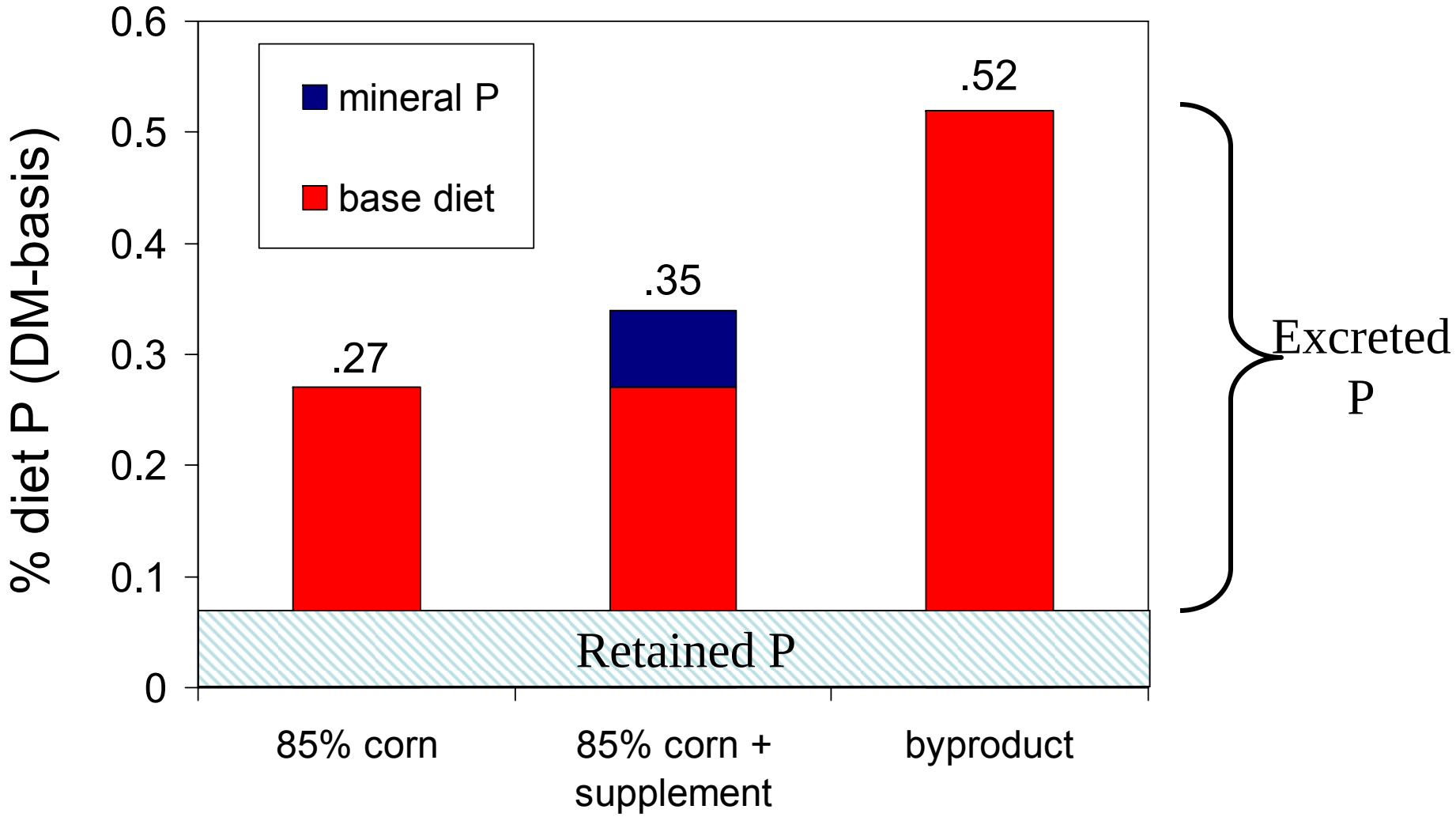
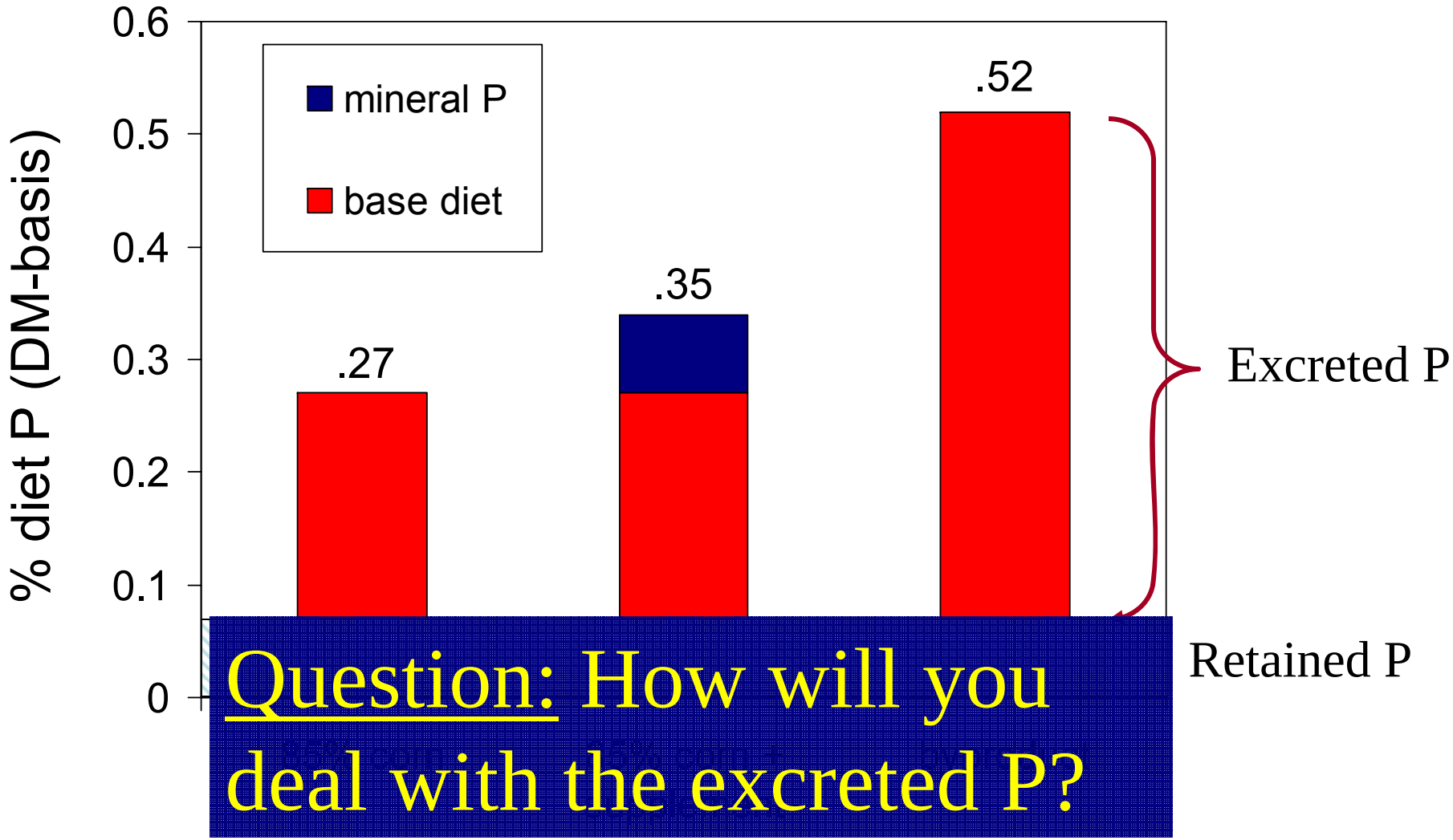


Dietary P in Feedlot Diets



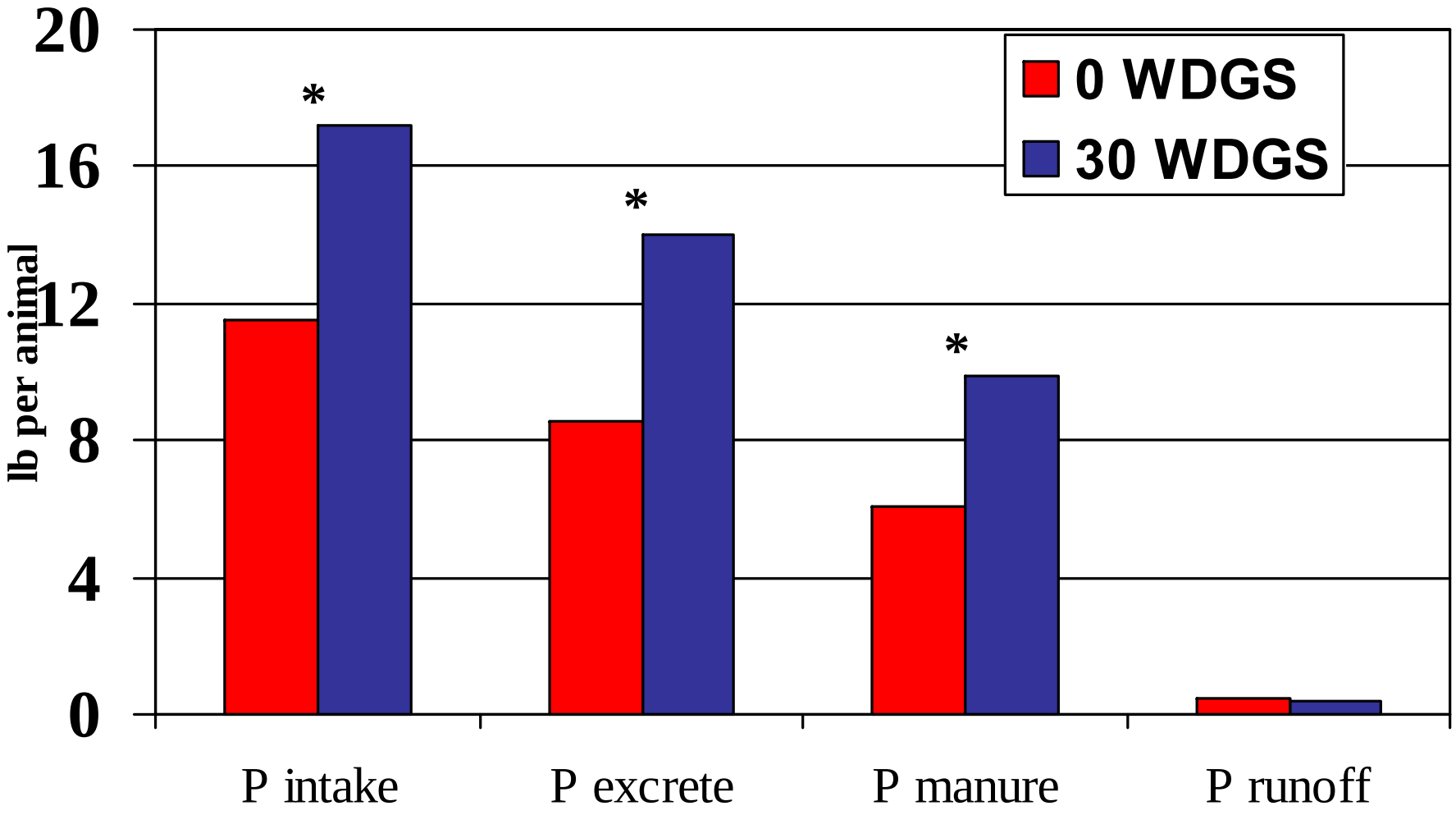
Dietary P in Feedlot Diets



Question: How will you deal with the excreted P?

Impact of DGS on P challenge

P mass balance-Winter



FNMP $

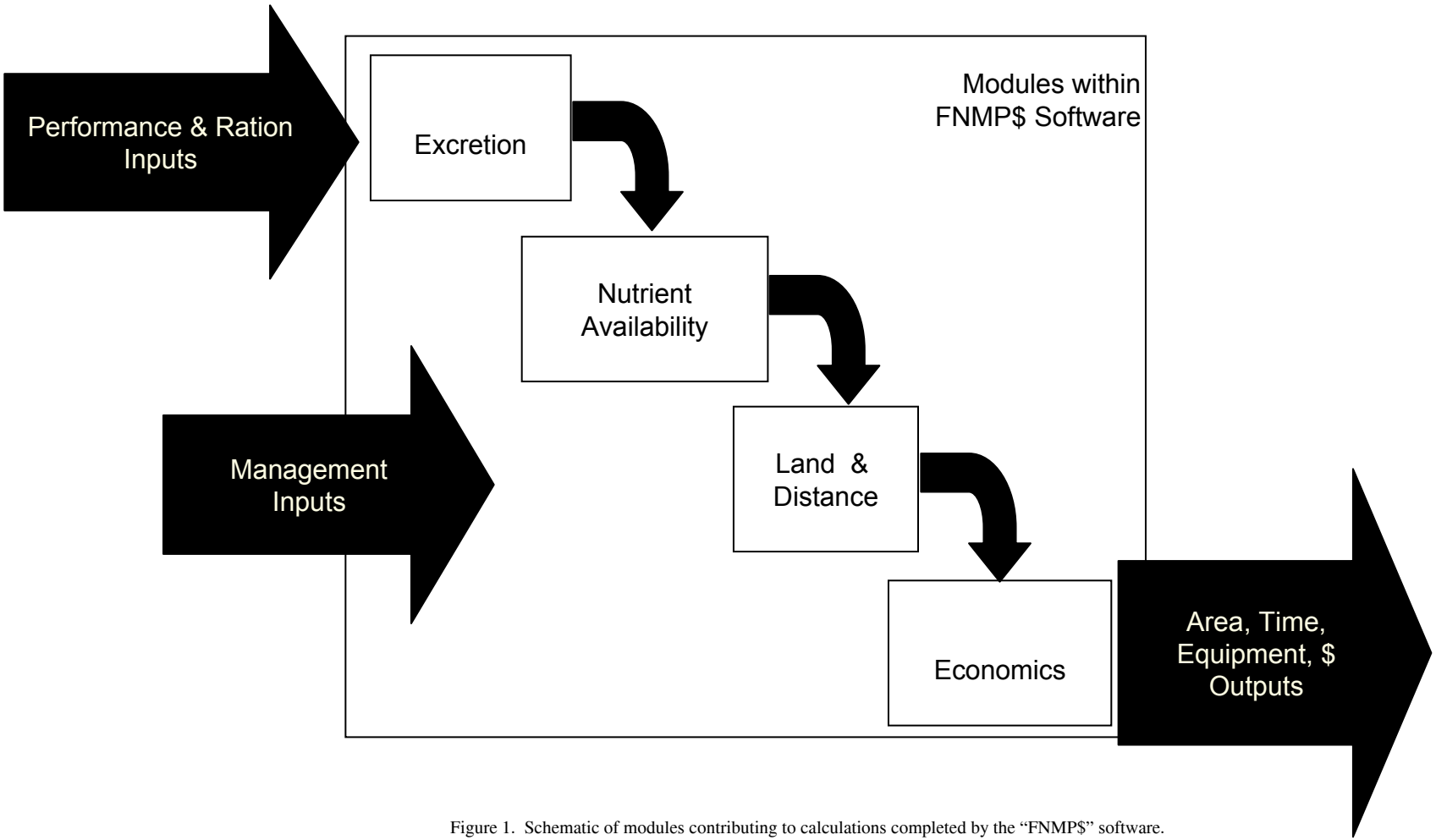


Figure 1. Schematic of modules contributing to calculations completed by the "FNMP$" software.

Impact of DGS on P challenge

Costs and Net Value, C-SB rotation
4-Yr P Basis, ($/hd)

	2500	10,000	25,000
COSTS			
0 byp 0.30 P	3.00	2.10	3.00
40 byp 0.50 P	3.90	3.30	5.75
NET VALUE			
0 byp 0.30 P	2.50	3.50	2.50
40 byp 0.50 P	6.10	6.80	4.30

Kissinger et al., 2006

Manure Composition

Item	Winter/Spring	Summer/Fall
Amt, lb	17.5	14.3
DM, %	70.6	76.5
OM, % DM	33.5	34.6
N, %	0.99	1.17
P, %	0.47	0.58
$P_2 O_5$, %	1.08	1.33

Manure Value[1]

Item	Winter/Spring	Summer/Fall
N, lb/ton	19.8	23.4
N Value, $/ton	10.89	12.87
P_2O_5, lb/ton	21.6	26.6
P Value, $/ton	21.17	26.07
N & P Value, $/ton	$32.06	$38.94

[1]N - $.55/lb, P_2O_5 - $.98/lb.

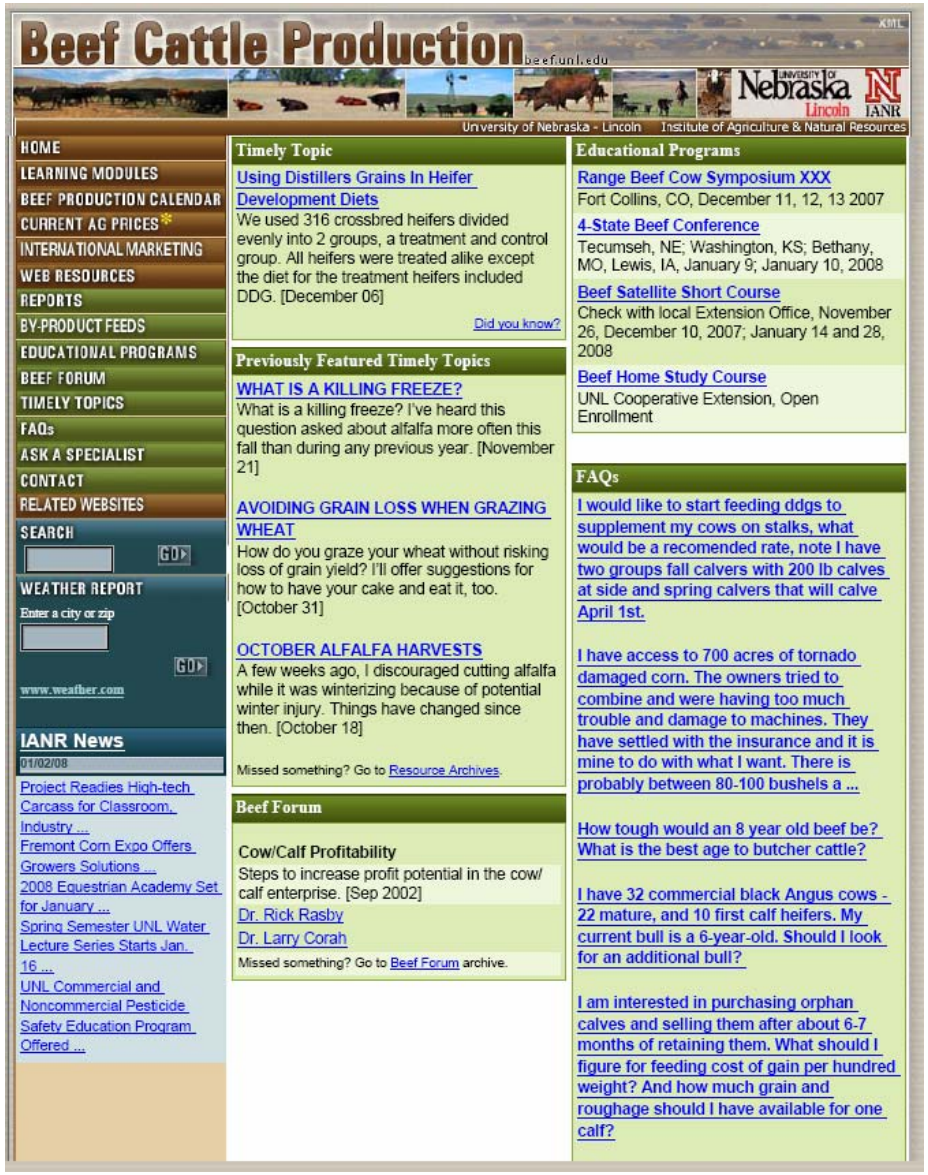
Costs and Net Value, C-SB rotation 4-Yr P Basis, ($/hd)

	2006 $ 10,000	2008 $ 10,000
COSTS		
0 byp 0.30 P	2.10	2.98
20 byp 0.40 P	2.70	3.77
40 byp 0.50 P	3.30	4.55
NET VALUE		
0 byp 0.30 P	3.50	17.43
20 byp 0.40 P	5.10	24.49
40 byp 0.50 P	6.80	32.19

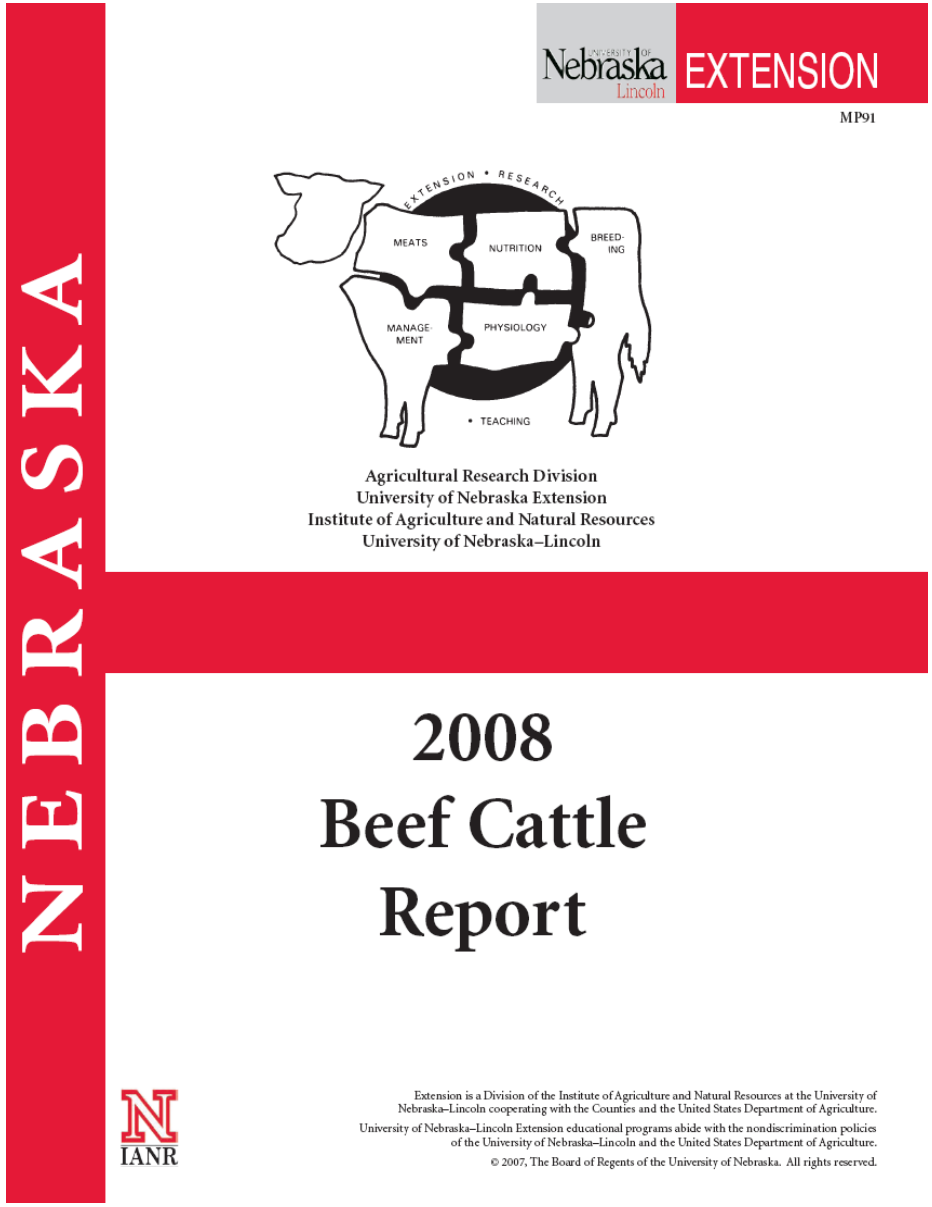
2008 Economics

Beef Extension Page

http://beef.unl.edu



Beef Reports



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Abengoa Bioenergy
Nebraska Corn Board
Cargill Wet Milling
UNL Foundation GARD
Poet Nutrition
Chief Ethanol
Nebraska Beef Council
US BioEnergy

Storage Demonstration Today

1 Small bags

2 Bagging with pressure, without

3 Bunker storage


Up North


DEERE
444J


Up North

Storage Demonstration Today

Bunkers

25% wheat straw with 75% WDGS in bunker

35% corn stalks with 65% WDGS in bunker

WDGS alone in bunker

Modified WDGS alone in bunker

50% wheat straw with 50% solubles

Bags

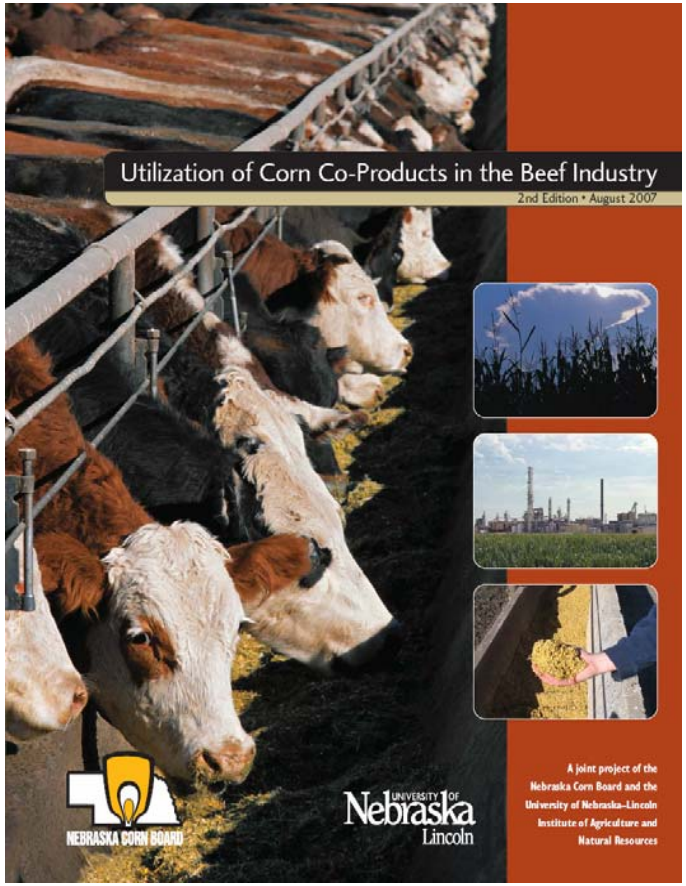
WDGS alone in bag

Modified WDGS alone in bag

75% wheat straw with WDGS in bag

75% wheat straw with solubles in a bag

BUNKER mixing today (WDGS and Modified WDGS)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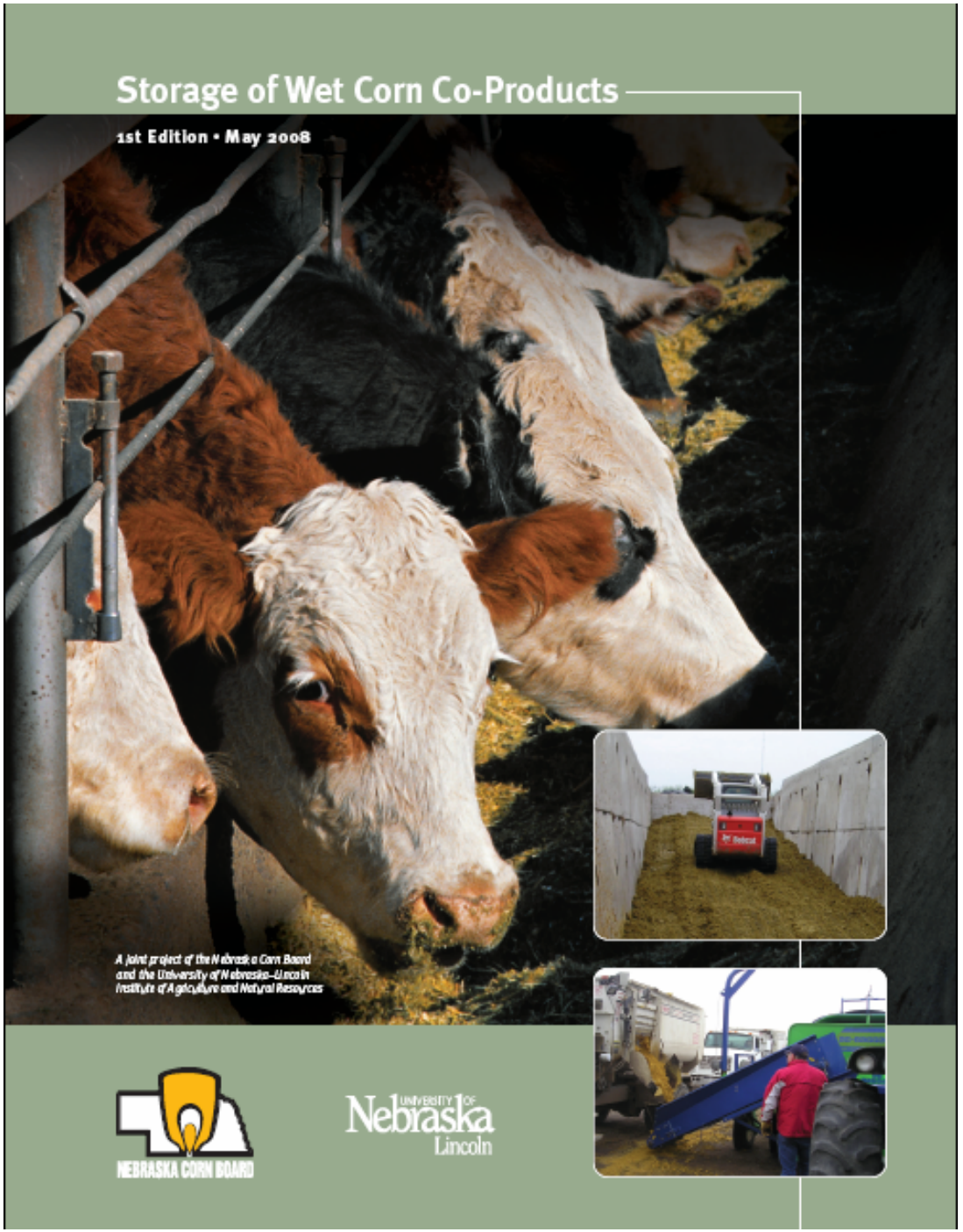
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