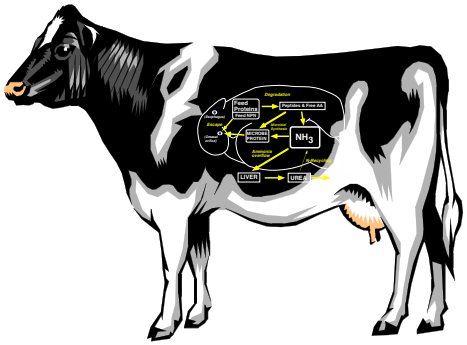
Constraints to Efficient Protein Utilization by the Dairy Cow and the Dairy Farm

RedNex-2
EAAP-15
27 August, 2012



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How can we Maintain Profitable Levels of Production on Low Dietary Protein?

Strategies to Improve N-Utilization

1. Optimize Microbial Protein in the Rumen
2. Feed Only the Crude Protein Needed
3. Feed Rumen-Undegraded Protein with Complementary AA Pattern
4. Supplementation with Protected EAA
5. Lose a Little Production/Maximize Efficiency
6. What Works on the Whole Farm?

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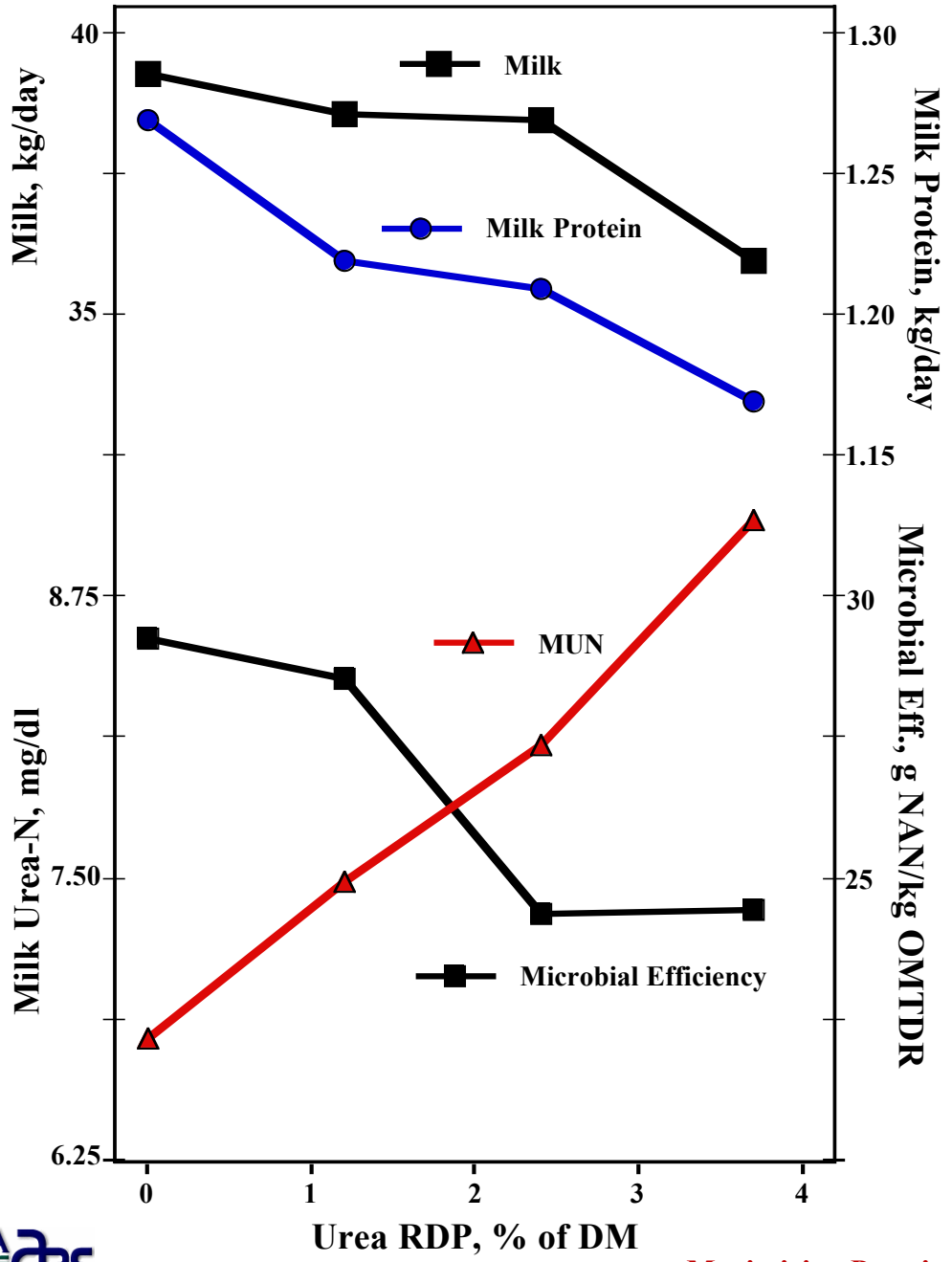
Meet Microbial Requirements for Rumen Degraded Protein (RDP)



Replacing RDP from True Protein with RDP from NPN Reduced N-Utilization

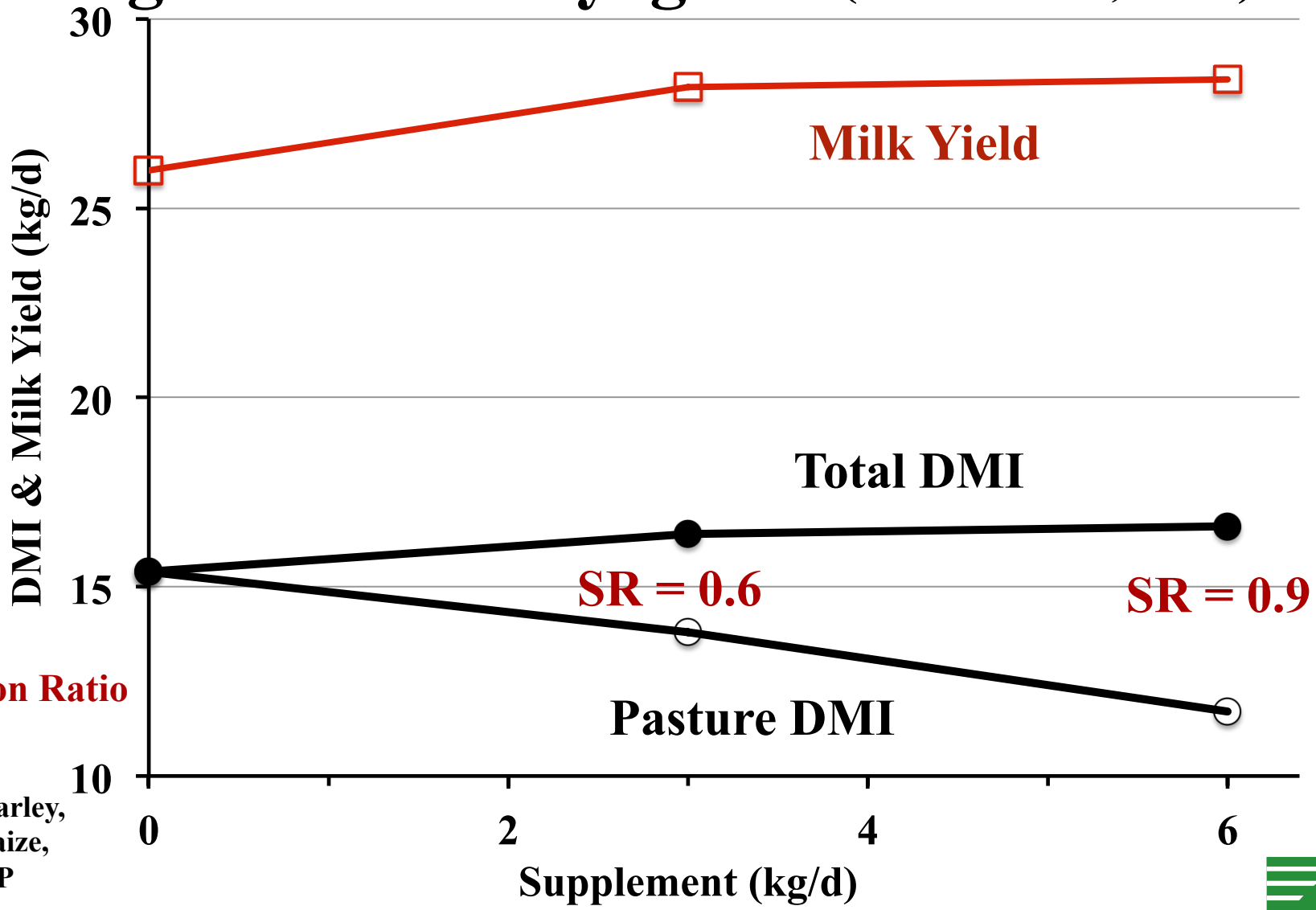
(16% CP; Solv. SBM, Treated-SBM, Urea)

(Broderick & Reynal, 2009)

Amino-N Stimulates Microbial Protein Formation

Optimize Carbohydrate Fermentation in the Rumen

Effect of Carbohydrate Supplementation of Cows Grazing Perennial Ryegrass (Wales et al., 2009)



SR = Substitution Ratio

Supplement = 65% Barley, 30% Steam-flaked maize, 5% Molasses; 10% CP

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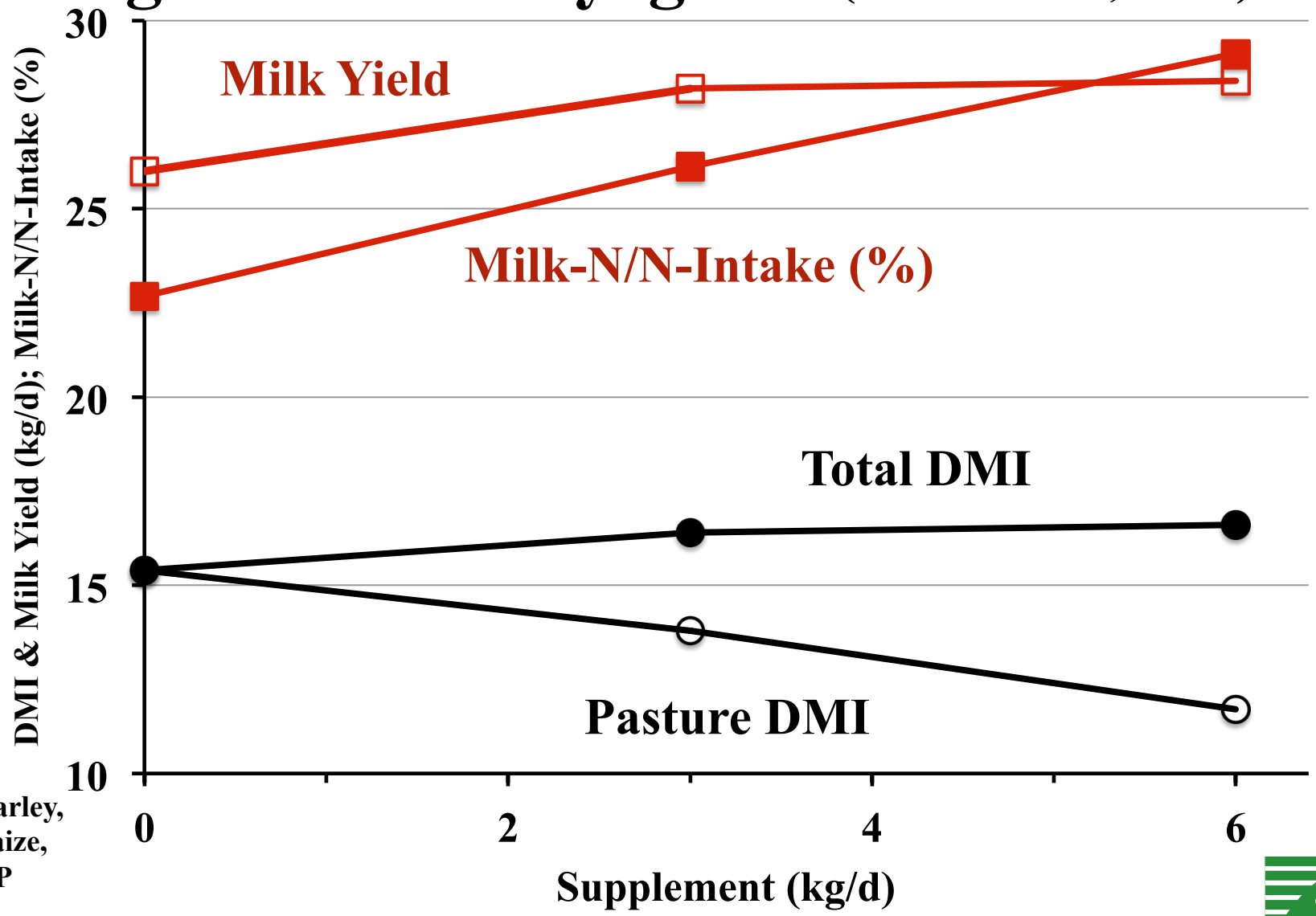

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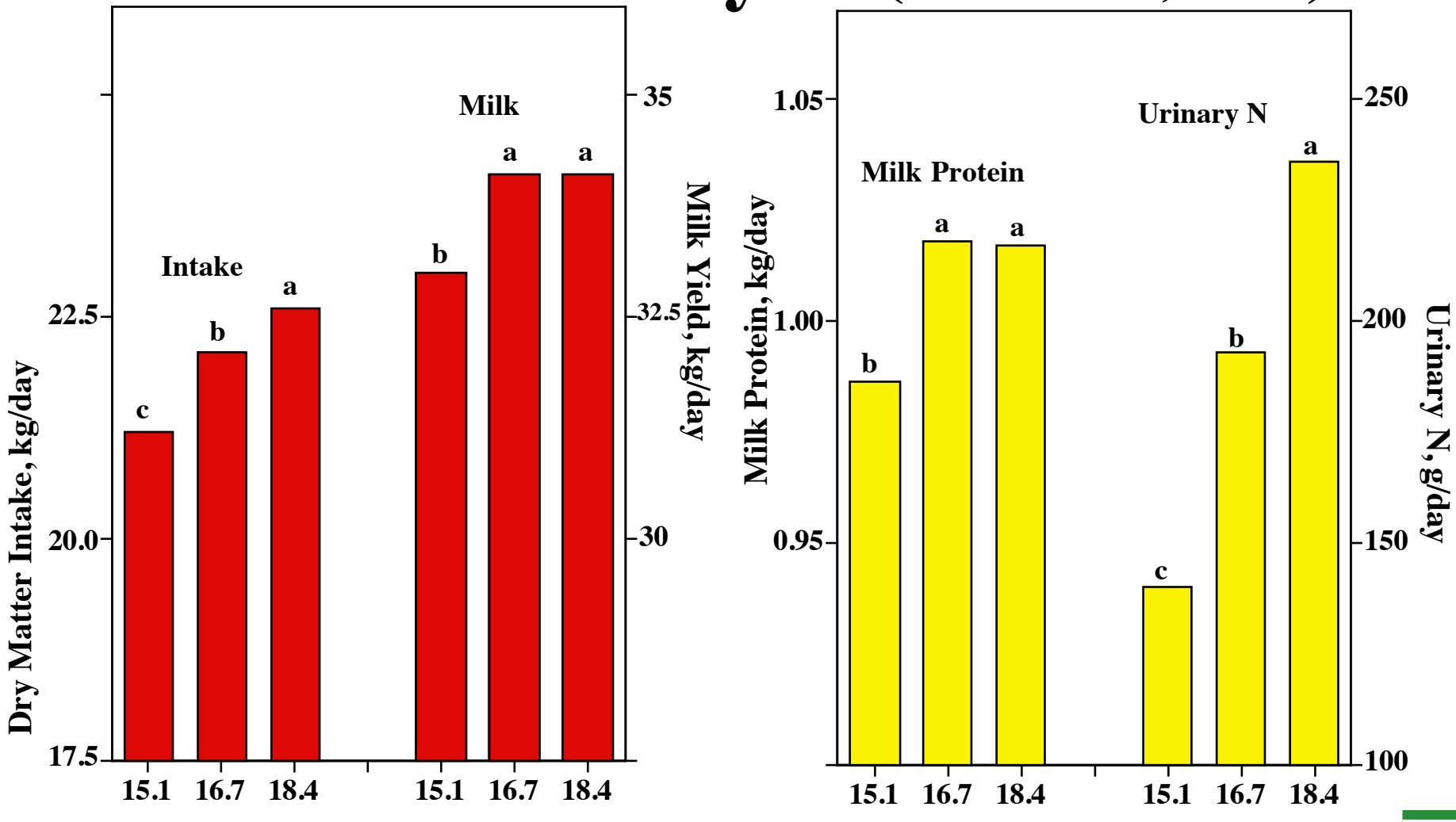
Production & Feeding--Top Wisconsin Herds

(Shaver et al., 1998)

RHA	Fat	Protein	Dietary CP
	-------(kg/lactation)-------		
14,200 (119 cows)	505 (3.55%)	425 (3.2%)	19.4% (18.5-21.5%) (28% NDF)

Effect of Dietary [CP] on Intake, Yield & Urinary N (Broderick, 2003)



Dietary Crude Protein, % of DM

Production & Feeding--Top 6 Free-Stall Wisconsin Herds (Shaver & Kaiser, 2004)

Rolling Herd Average	Fat	Protein	Dietary CP
----------(kg/lactation)----------			
14,000 (396 cows)	519 (3.75%)	415 (3.0%) (true protein)	17.7% (16.7-18.4%) (29% NDF)

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CP Supplement & Production in Dairy Cows

(Brito & Broderick, 2007)

Item	CP Supplement				*Prob.*
	Urea	SSBM	CSM	CM	
	----------(kg/d)----------				
DM intake	22.1^{c}	24.2^{b}	24.7^{ab}	24.9^{a}	< 0.01
Milk	32.9^{b}	40.0^{a}	40.5^{a}	41.1^{a}	< 0.01
True protein	0.92^{c}	1.23^{ab}	1.18^{b}	1.27^{a}	< 0.01
Milk-N/NI, %	24.9^{c}	30.4^{a}	28.5^{b}	30.2^{ab}	< 0.01

(Lucerne & Maize Silages, High Moisture Maize, 16.5% CP)

SSBM = Solvent Soybean Meal; CSM = Cottonseed Meal; CM =Canola (Rapeseed) Meal;

$^{a\text{-}c}$($P < 0.05$)

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Milk	32.9^{b}	40.0^{a}	40.5^{a}	41.1^{a}	< 0.01
True protein	0.92^{c}	1.23^{ab}	1.18^{b}	1.27^{a}	< 0.01
Milk-N/NI, %	24.9^{c}	30.4^{a}	28.5^{b}	30.2^{ab}	< 0.01

(Lucerne & Maize Silages, High Moisture Maize, 16.5% CP)

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CP Supplement & Protein Flow from the Rumen (Brito et al., 2007)

Item	Diets[1]				*Prob.*
	Urea	SSBM	CSM	CM	
Microbial eff. (g NAN/kg of OMTDR)	26.3[b]	29.0[a]	29.7[a]	29.5[a]	<0.01
	----------g/d----------				
Microbial protein	2344[b]	2706[a]	2706[a]	2775[a]	0.04
Escaped protein (RUP)	538[c]	987[b]	1348[a]	1150[ab]	<0.01
Total protein	2882[c]	3693[b]	4054[a]	3925[ab]	<0.01

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[a-c]($P < 0.05$)

Lys & Met Contents of Different Proteins (NRC, 2001)

Item	Cow's Milk	Bacterial Protein	Solvent SBM	Cottonseed meal	Canola meal
	----------(% of EAA)----------				
Lys	16.0	15.8	13.9	9.7	13.2
Met	5.5	5.2	3.2	3.7	4.4
Lys:Met	2.9	3.0	4.4	2.6	3.0
His	5.5	4.0	6.1	6.6	6.6

Greater Milk Protein Yield on Canola/Rapeseed due to Better EAA Pattern

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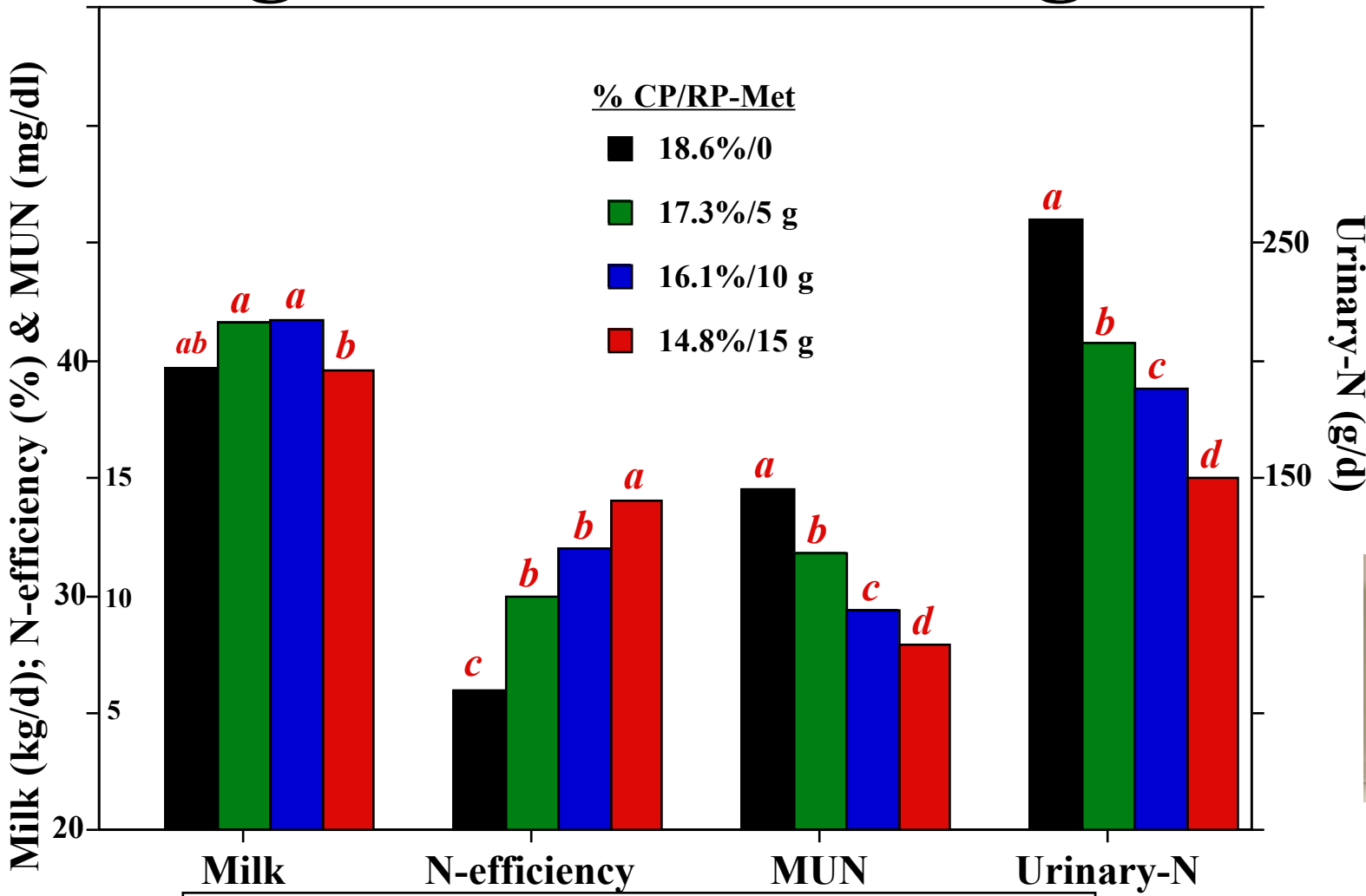
Effect on Production & Efficiency of Lowering SBM-CP, Adding RP-Met



[a-d](P < 0.05); RP-Met = g Rumen protected Met/d from Mepron

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Effect of Lowering CP & Increasing RUP

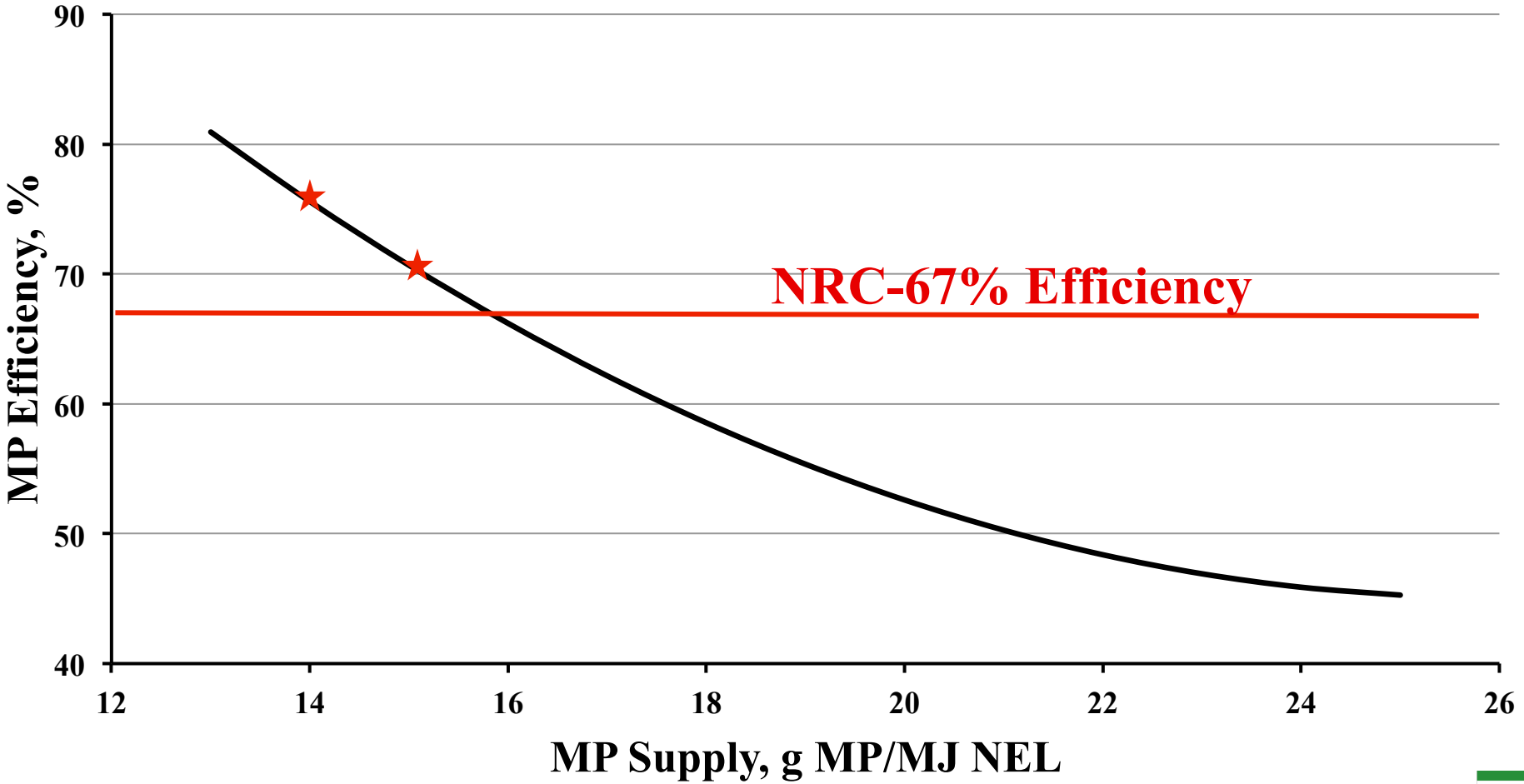
Ingredient	Normal 17.5% CP	RUP/RP-Met 14.0% CP
	---------(% of DM)---------	
Lucerne silage	25	10
Maize silage	35	50
High moisture maize	24.3	25.2
Solvent SBM	13.3	0
Expeller (heated) SBM	0	12.4
Protected-Met (Mepron, SmartAmineM, MetaSmart)	*0*	*0.06 (Lys/Met = 3.0)*

Effect of Lowering CP & Increasing RUP*

Item	Normal 17.5% CP	RUP/RP-Met 14% CP
MP, kg/d	2.41	2.27
NE_L-ECM, kg/d	38	38
MP-Milk, kg/d	41	41
Milk-N/NI, %	28	35
Manure-N/NI, %	72	65
Manure-N, kg/Lact.	154	111

*Estimated using the NorFor (2011) Model (DMI = 25 kg/d)

NorFor—Decline in MP Efficiency for Milk Protein with Increasing MP Supply



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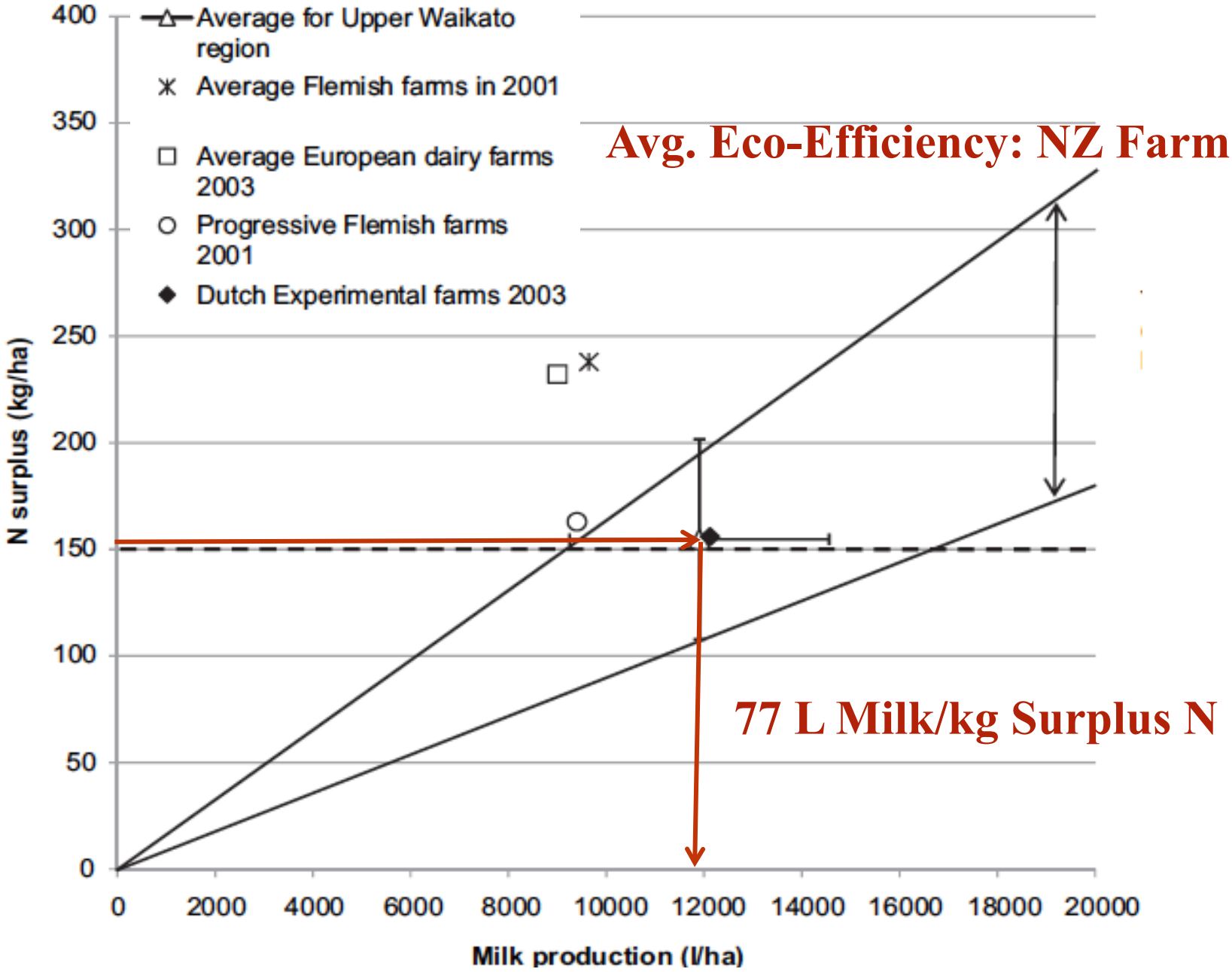
Farm-Gate N Surplus vs. Milk/ha (Beukes et al., 2012)



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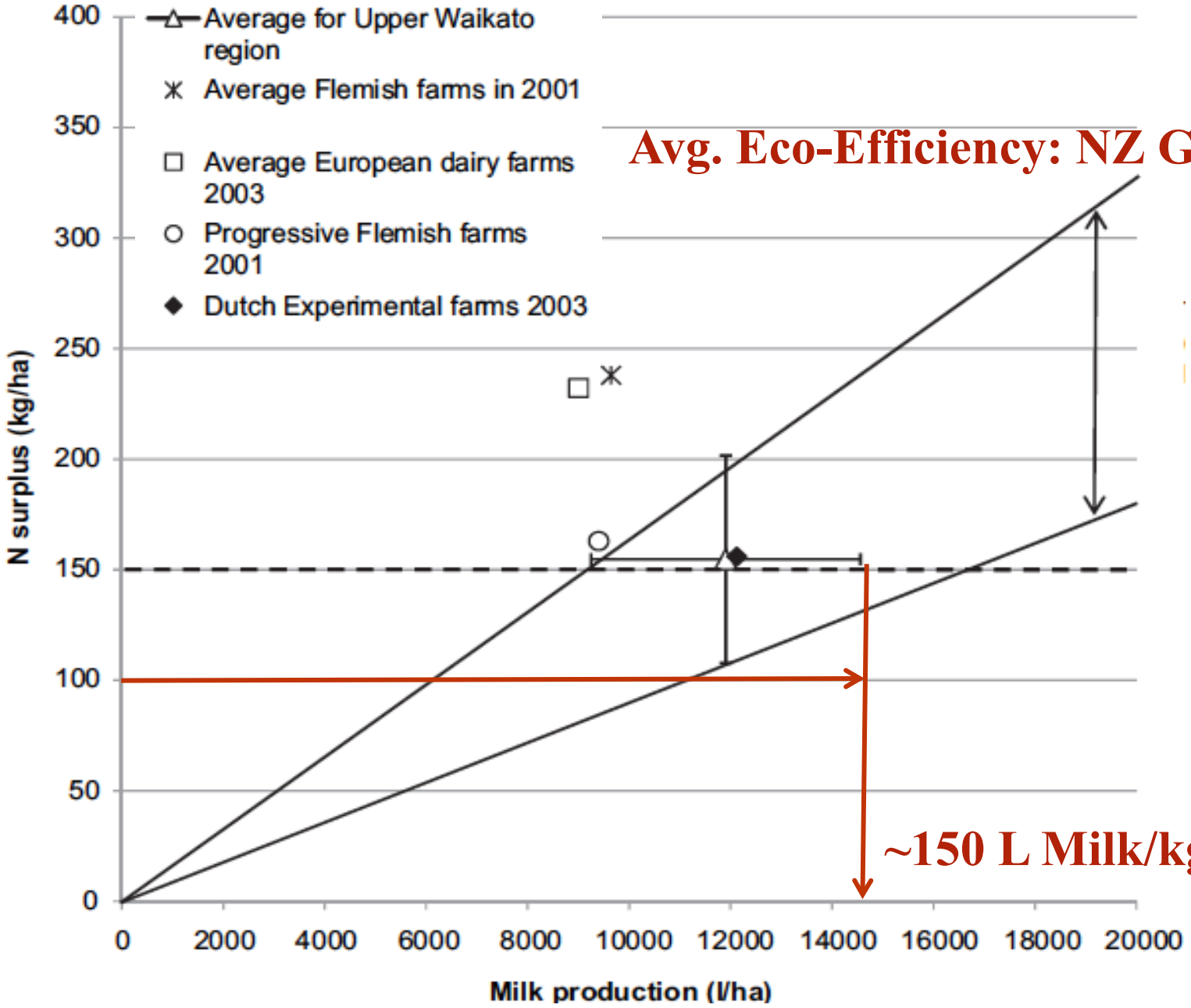


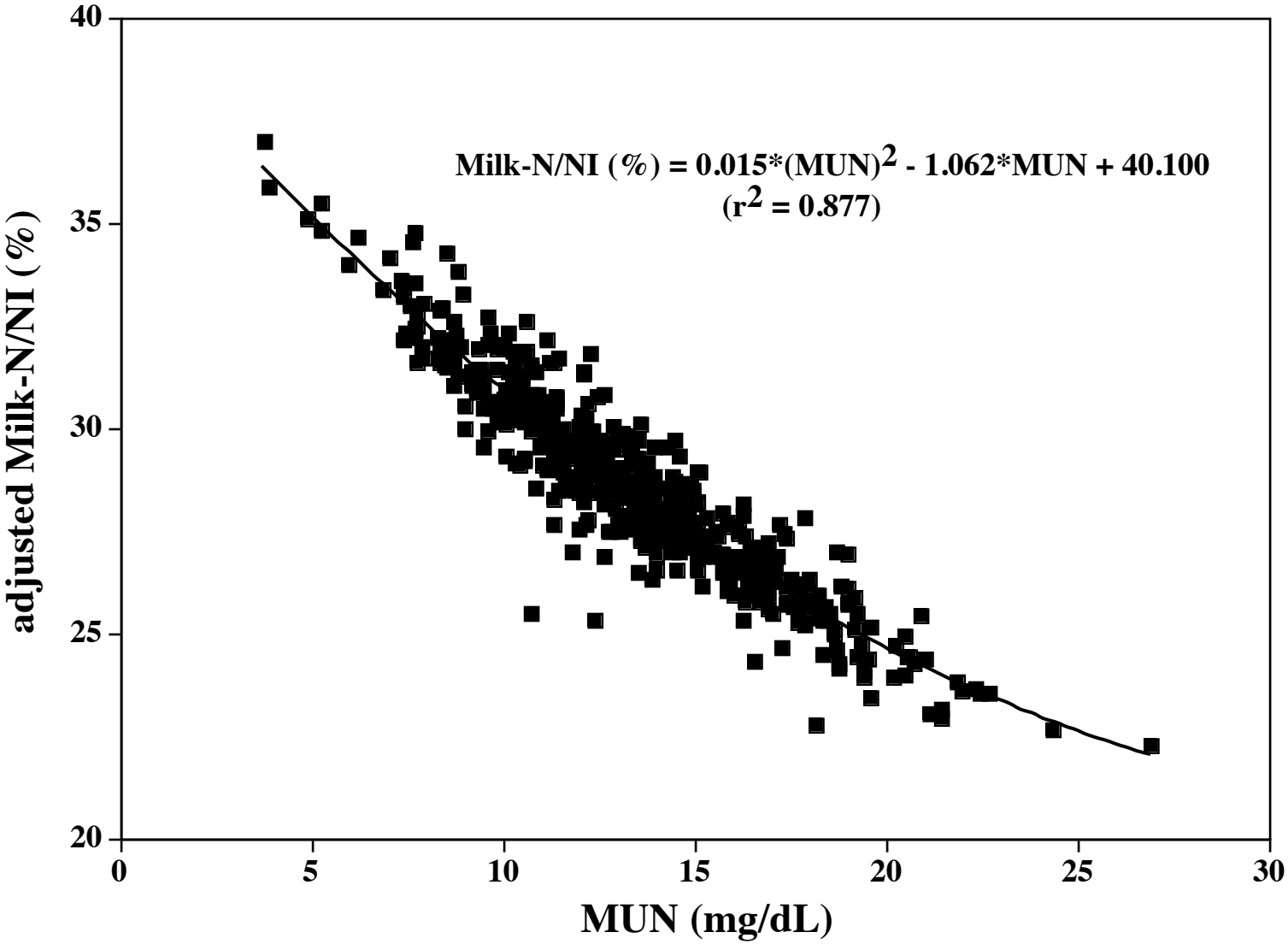
Avg. Eco-Efficiency: NZ Goal

~150 L Milk/kg Surplus N

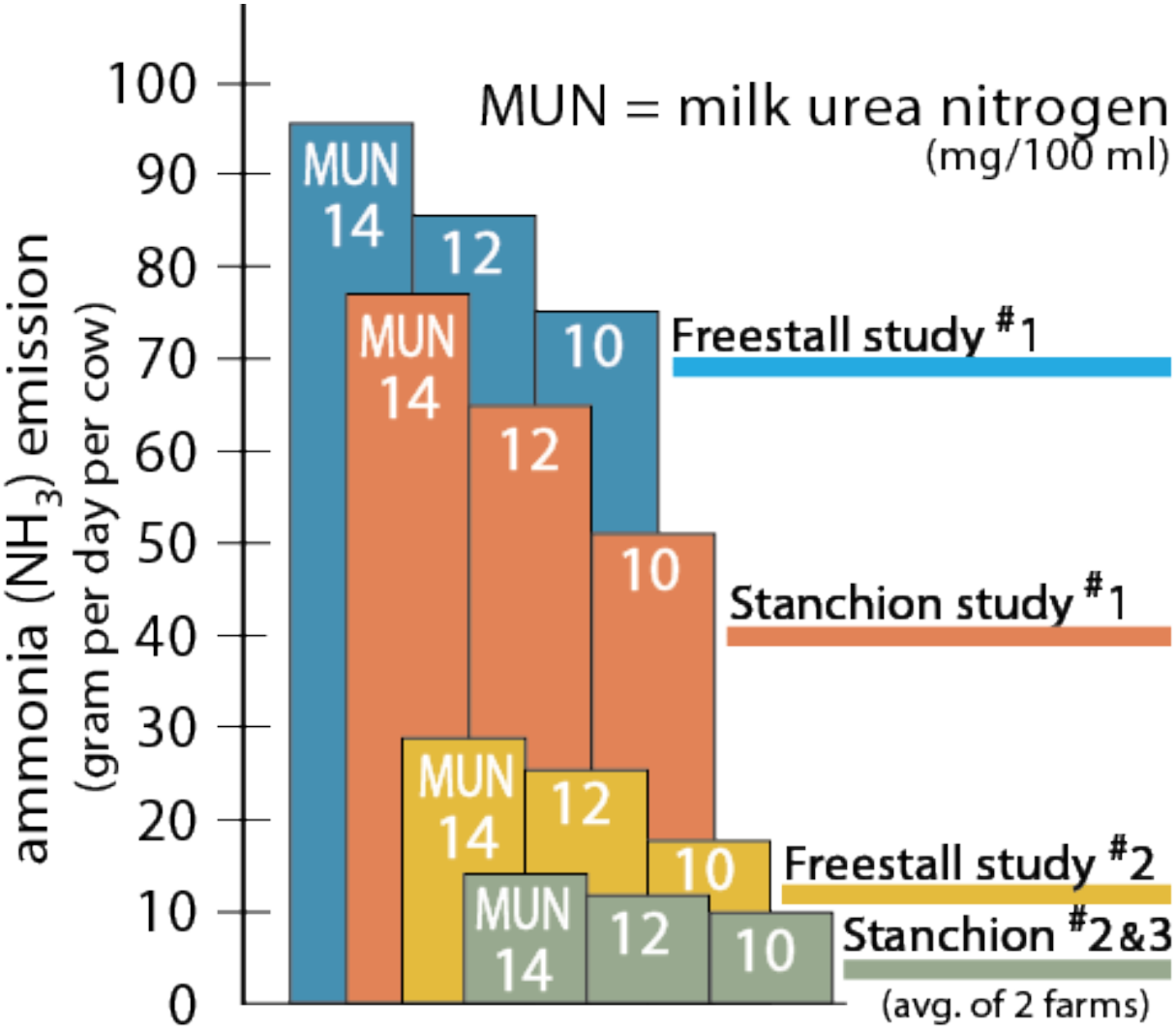
Strategies to Reduce Farm-Gate N-Surplus/kg Milk (Kohn et al., 1998; Spears et al., 2003)

1. **Improving Milk-N/N-Intake Most Effective**
2. **Improving Crop N-Utilization (e.g., Availability of Manure-N to Crops)**
3. **Manure N Storage Efficiency**

MUN & N-Efficiency (MTT Data)



NH_3 Emission & MUN (Powell et al., 2011)



Avg. NH_3 Reductions:

14 to 12 mg/dl =13%

14 to 10 mg/dl = 26%

Summary & Conclusions

1. Optimize Microbial Protein
2. Balanced Diets Can be Reduced to ≤16.5% CP
3. Feed RUP With Complementary AA Patterns
4. Supplementation with RP-AA may be Useful
5. Lower CP Diets may Improve MP-Efficiency
6. Strategies that Improve N-Efficiency in the Cow
   Improve N-Efficiency of the Dairy Farm