A photograph of a cow grazing in a cornfield, with the cow's head and the corn stalks visible. The image is semi-transparent, allowing text to be overlaid.

Optimizing Intake Through Management: What to Expect?

Intake = time grazed X bites/min X bite size

University of Missouri Pasture-based Dairy Team:

W. Prewitt; T. Probert; T. Rickard; S. Pooch; R. Kallenbach;

R. Milhollin; J. Horner; S. Hamilton

Pasture Intake: Why Worry about it?



“Feed What We Got” Syndrome

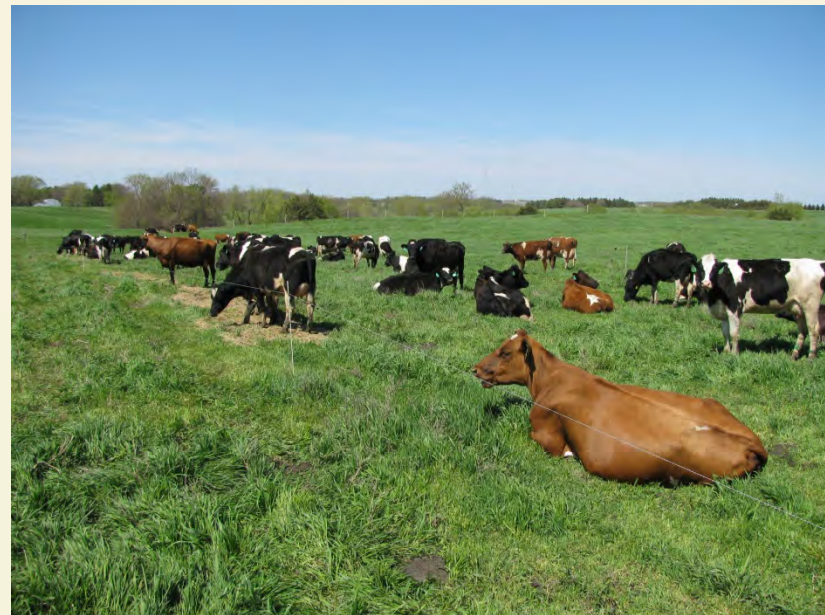
Can we achieve this kind of pasture intake?



- ~40# DM pasture
- 85% water
- 15% fiber digestion/hour

Methods of Estimating Intake

- Milk Back-calculation
- Pre-post pasture disappearance
- “Markers”
- Esophageal fistulae



Pasture Intake: Why Worry about it?

- **Pasture-based dairy cows yield less milk due to reduced DMI and not forage quality**
- **How do you know what/amount to supplement?**
- **Grow only so much forage....don't waste it!**
 - **High utilization-low post-grazing residuals**
 - Cost effective
 - Grow 4 tons/acre @ 90% utilization = 3.6 tons consumed
 - Assume cow requires 5-5.5 tons/year
 - Stocking rate of 1:1 requires ~1.65 tons supplement
 - Fully fed cows?
 - Impact on stand longevity if grazing below plant's physiological point?
 - High Forage quality
 - **Moderate utilization-high post-grazing residuals**
 - Forage cost increase based on wastage
 - Grow 4 tons/acre @
 - 60% utilization = 2.4 tons consumed
 - Assume cow requires 5-5.5 tons/year
 - Stocking Rate of 1:1 requires ~2.85 tons supplement
 - Cows fully fed
 - Stands at less risk
 - Forage quality at risk

Managing the Plant for Intake

- Every plant species has “rules”
- Understanding of when these “rules” can be violated and when they can’t

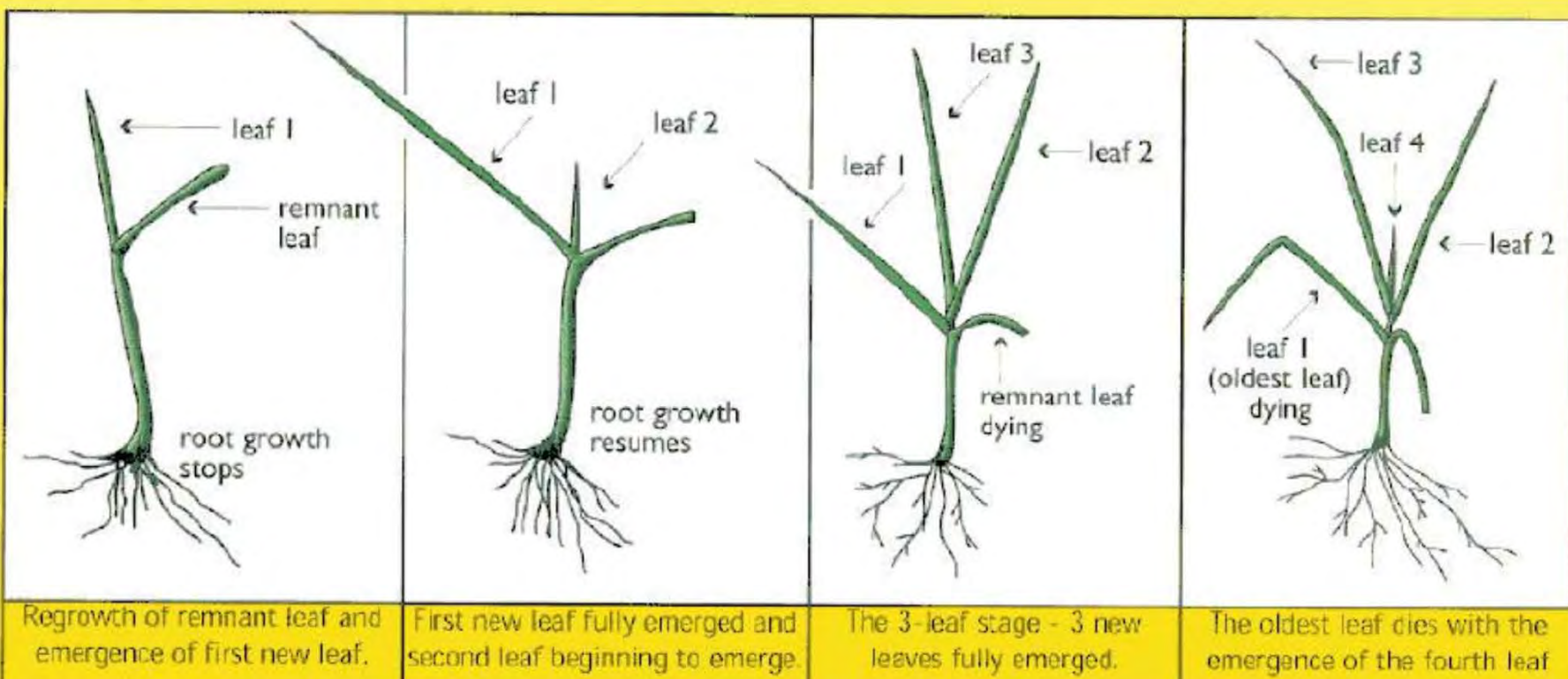


Example: Perennial Ryegrass

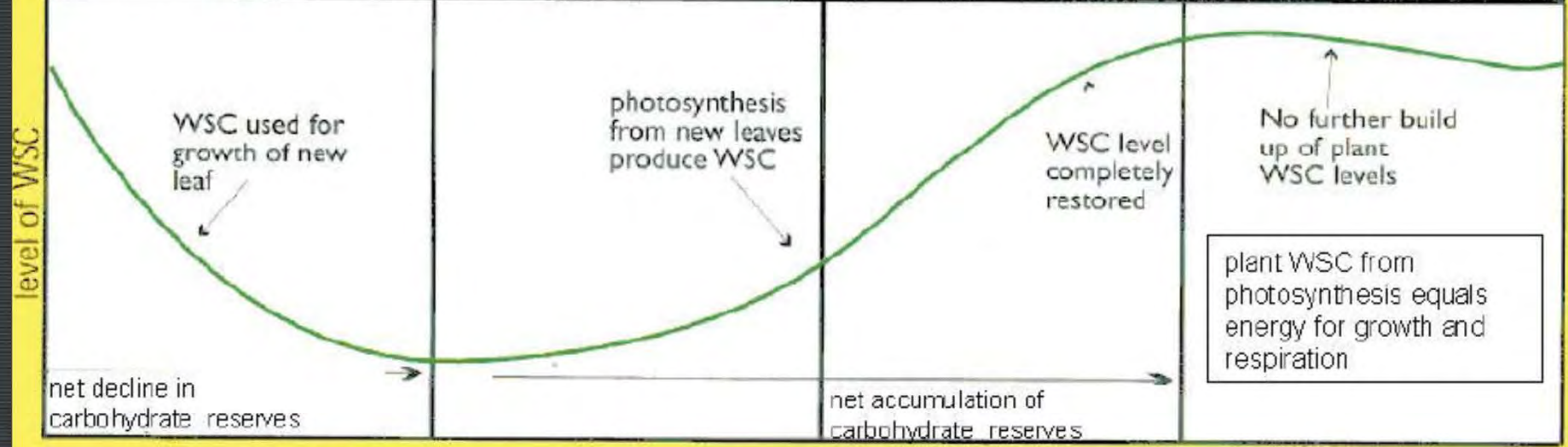
- 3 leaf plant
 - 1st leaf 10-15% of dry matter
 - 2nd leaf 30-45% of dry matter
 - 3rd leaf 45-55% of dry matter



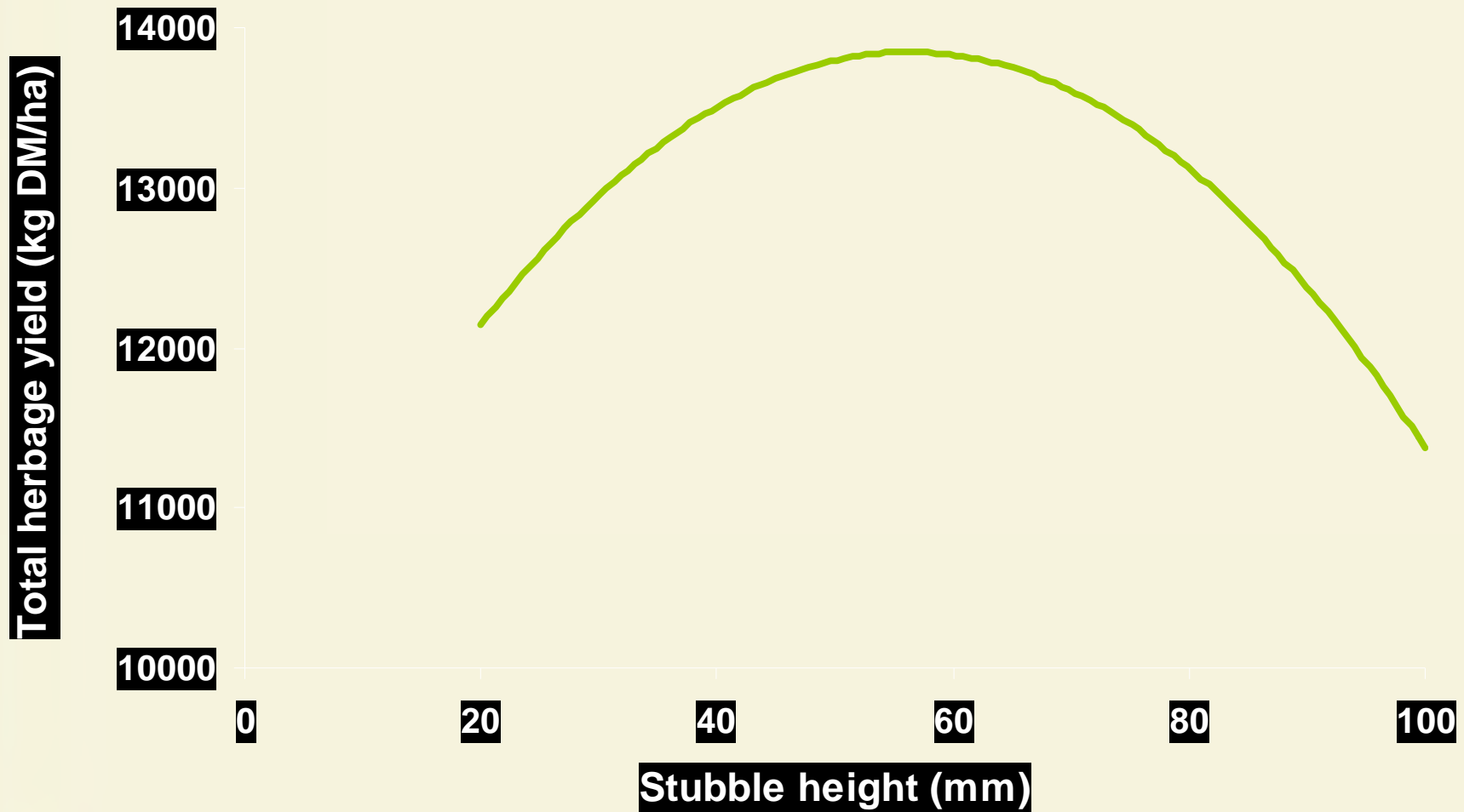
- Graze at 2.5-3 leaf optimizes intake and quality
- Grazing beyond 3 leaf sacrifices quality
 - Reduces overall yield?
- Graze to 2 inches



WATER SOLUBLE CARBOHYDRATE LEVELS (WSC) IN RYEGRASS PLANTS



Total herbage yield



Lee et al

Does Fiber (NDF) Play a Role in Controlling Intake?

- Dry matter intake (% of live weight) = $120 / \text{Pasture NDF (\% DM)}$ is generally accepted equation for intake
- Example: 1000# cow * 1.2% = 12# NDF
 - Pasture @ 44 NDF predicts intake of 26#
 - Pasture @ 55 NDF predicts intake of 22#
 - MU SWC Dairy is indicating 1.45% of body weight NDF (~30# forage)
- Roche et al. (2008) reviewed 21 papers (205 treatments) and found NDF to be poor predictor of pasture intake ($R^2 = 0.22$) in well managed pasture systems

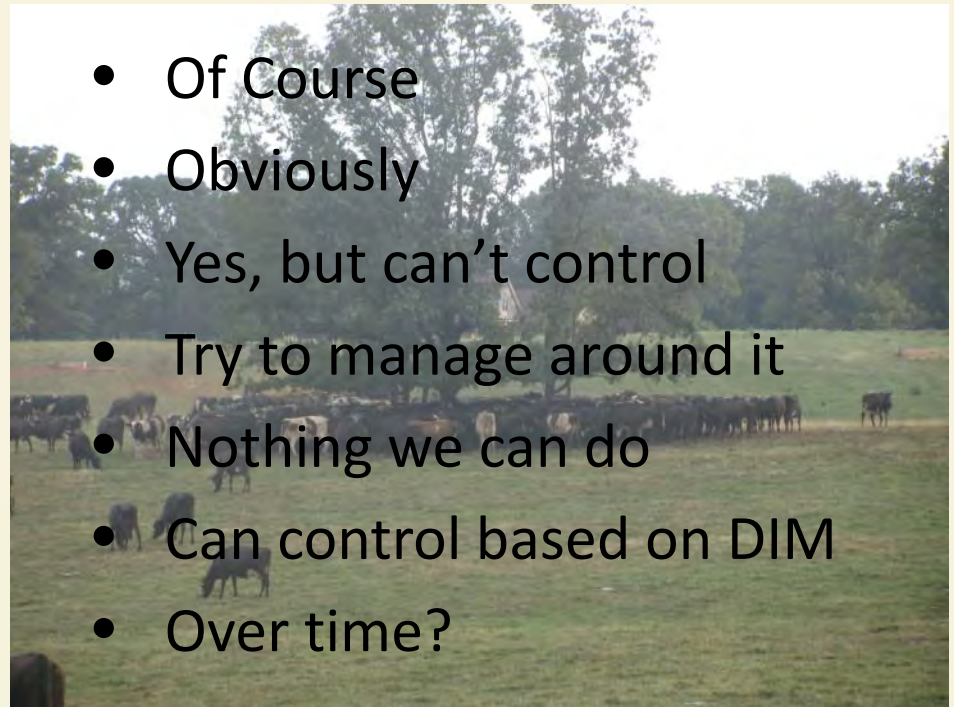
Does Fiber (NDF) Play a Role in Controlling Intake?

- Research is suggesting 1.5-1.7% of bodyweight in NDF intake
 - Indicates total pasture intakes of 3.0-3.5% of bodyweight
- NDF less than 48-50 may not have effect on intake
- Fiber in well managed C3 grasses highly digestible (>65%)
- Fiber in C4 grasses (tropical) not as digestible (<50%) and may have effect

What Factors then do Play a Role?

Factors

- Management
- Feed allowance
- Day length
- Weather
- Stage of lactation
- Level of production
- Genetics



- Of Course
- Obviously
- Yes, but can't control
- Try to manage around it
- Nothing we can do
- Can control based on DIM
- Over time?

What Tells the Cow “To Eat or not to Eat”?

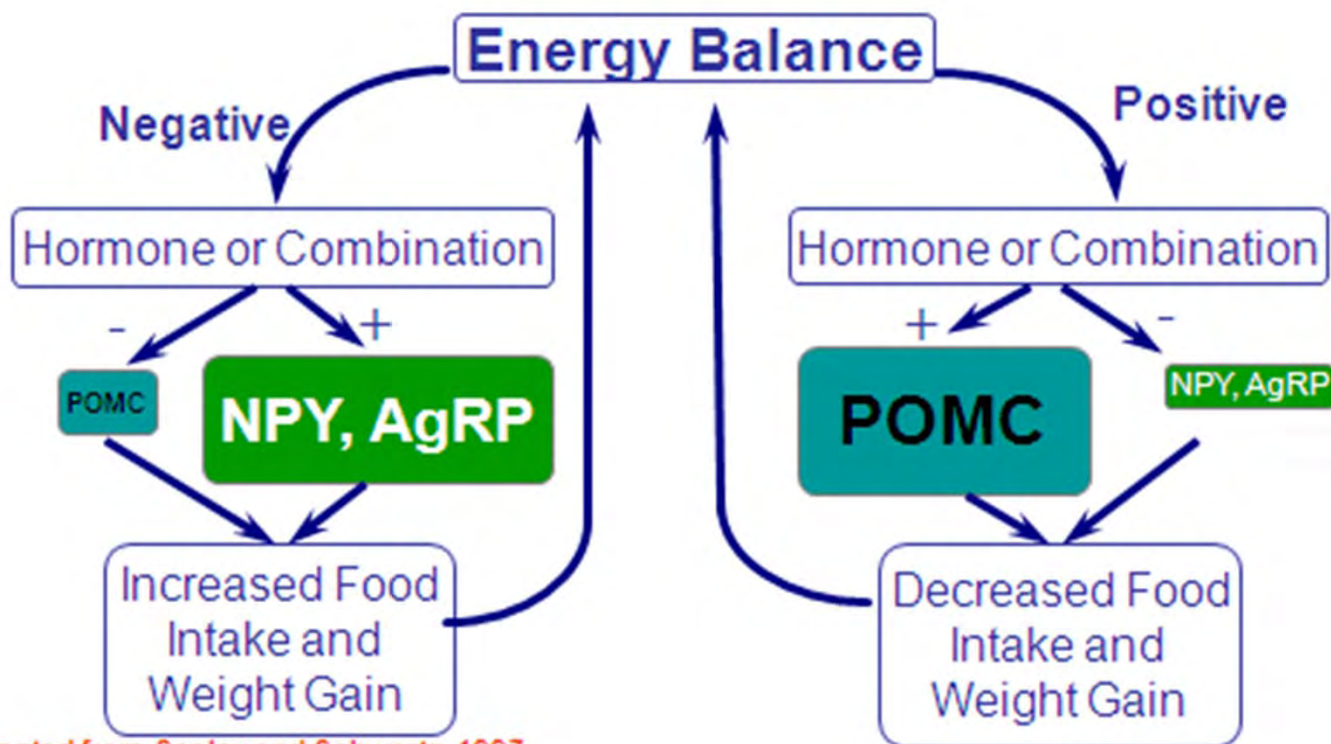
- Fiber and “stretch receptors” in GI tract
- Neuroendocrine system



- Day length-diurnal effect
- Weather conditions
- Probably not unless poor quality forage
- Yes...orexigenic and anorexigenic neurohormones
- Sheep studies
- Recent pasture dairy studies
- Yes to both



A "Simple" Model



Adapted from Seeley and Schwartz, 1997

NPY = Neuropeptide Y
POMC = Pro-opiomelanocortin
AgRP = Agouti-related protein

Multipliers of Pasture Intake

Time Grazing

- Weather/day length related?
- Well fed cows little impact-~480 minutes
- Effected by supplementation (reduces grazing 12 min/2.2# suppl.)
 - Substitution rate of 0.32

Bite Rate

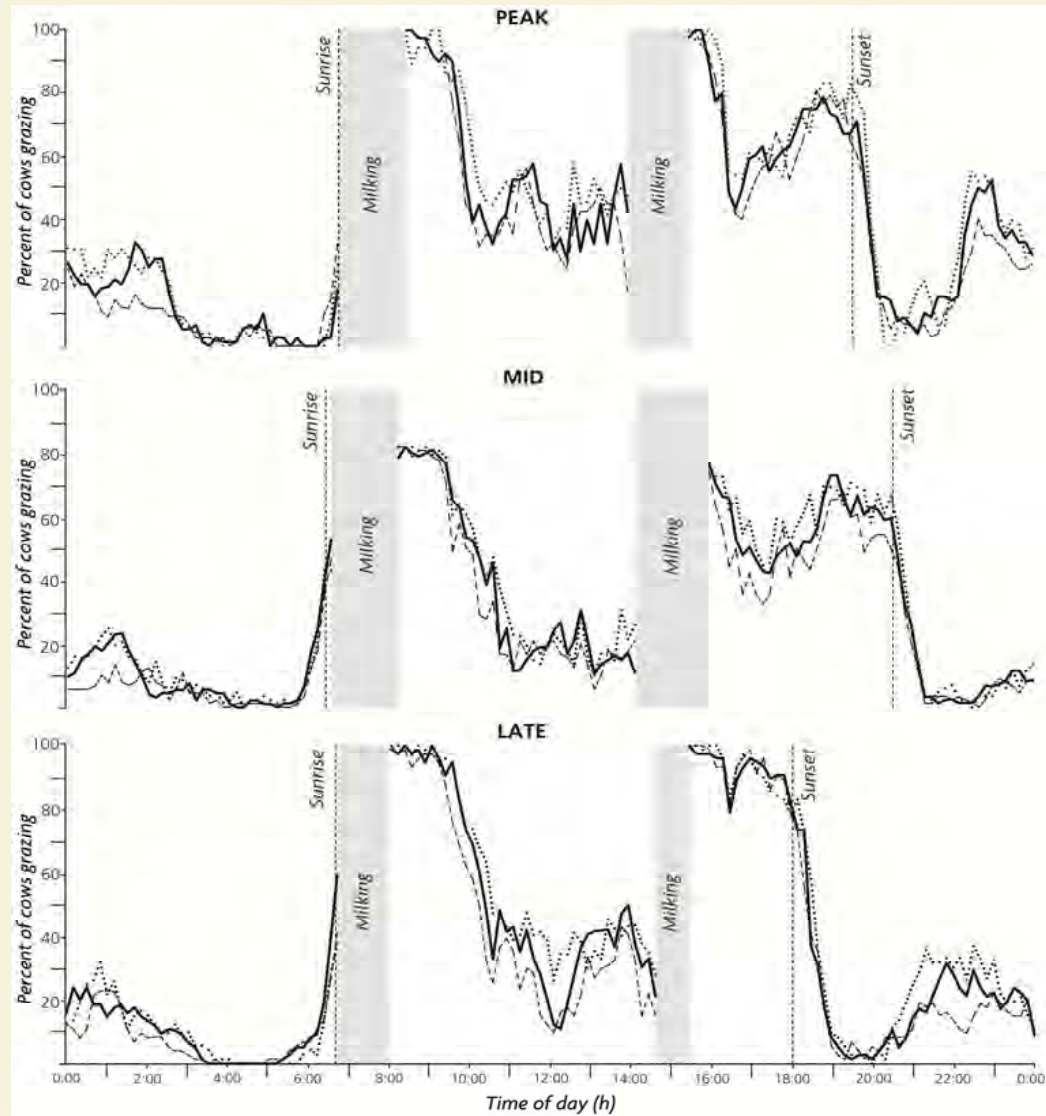
- Not much impact
- Bite Rate average = 58 bites/min
- Not effected by supplementation

Bite Size

- Yes—management can impact intake
- Offer how much forage for desired intake?
- Bite size/mass average = 0.46 grams/bite
- Not effected by supplementation

Intake of 28.2# pasture

Day Effects



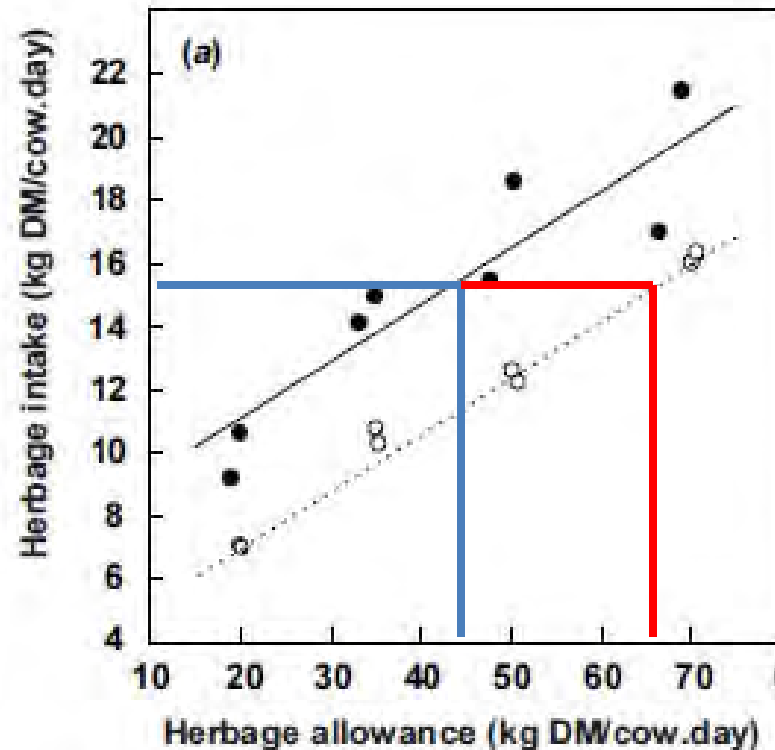
Sheahan et al

Figure 1. Diurnal profile of cows grazing during peak, mid, and late lactation when offered 0, 3 or 6 kg DM/d concentrate (0 kg DM/d = dotted line, 3 kg DM/d = solid line and 6 kg DM/d = dashed line). Shading represents milking time, and vertical dashed lines represent sunrise and sunset.

Pasture Allowance Drives Intake

- More than likely via bite size
- 7 studies developed equation:
 - Pasture Intake (kg) = $7.79 + 0.26 (\text{pasture allowance (kg)}) - .0012 (\text{pasture allowance}^2 (\text{kg}))$;
 $R^2=0.95$
- For maximum intake (48.2# cow/day) offer 242# cow/day
- Or 3-5 times desired intake

Relationship between Herbage Allowance and Pasture Intake



	Low Mass	High Mass
Mass	3120 kg/ha	4890 kg/ha
Height(cm)	5.6	12.6

Figure 1. Experiment 1. (a) Relationships between herbage allowance (HA) and herbage dry matter intake (DMI) for cows grazing irrigated perennial ryegrass–white clover low mass (○) and medium mass (●) swards (HM; t DM/ha). The equation of the line is:

$$DMI = -3.8 + 0.18 (\pm 0.014) HA + 2.29 (\pm 0.278) HM \quad (100r^2 = 94.2; r.s.d. = 0.99; CV = 7.4\%; P < 0.01)$$

Relationship between Herbage Allowance and Milk Yield

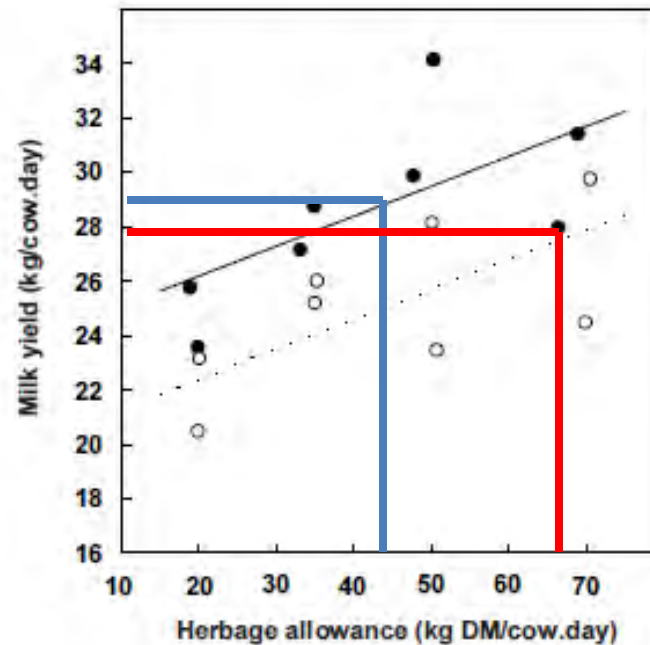


Figure 3. Experiment 1. Relationships between herbage allowance (HA) and milk yield (MY) by cows grazing irrigated ryegrass-white clover low mass (○) and medium mass (●) swards (HM; t DM/ha). The equation of the line is:

$$MY = 13.7 + 0.11 (\pm 0.03) HA + 2.1 (\pm 0.65) HM$$

($100R^2 = 52.6$; r.s.d. = 2.42; CV = 9.0%; $P < 0.01$)

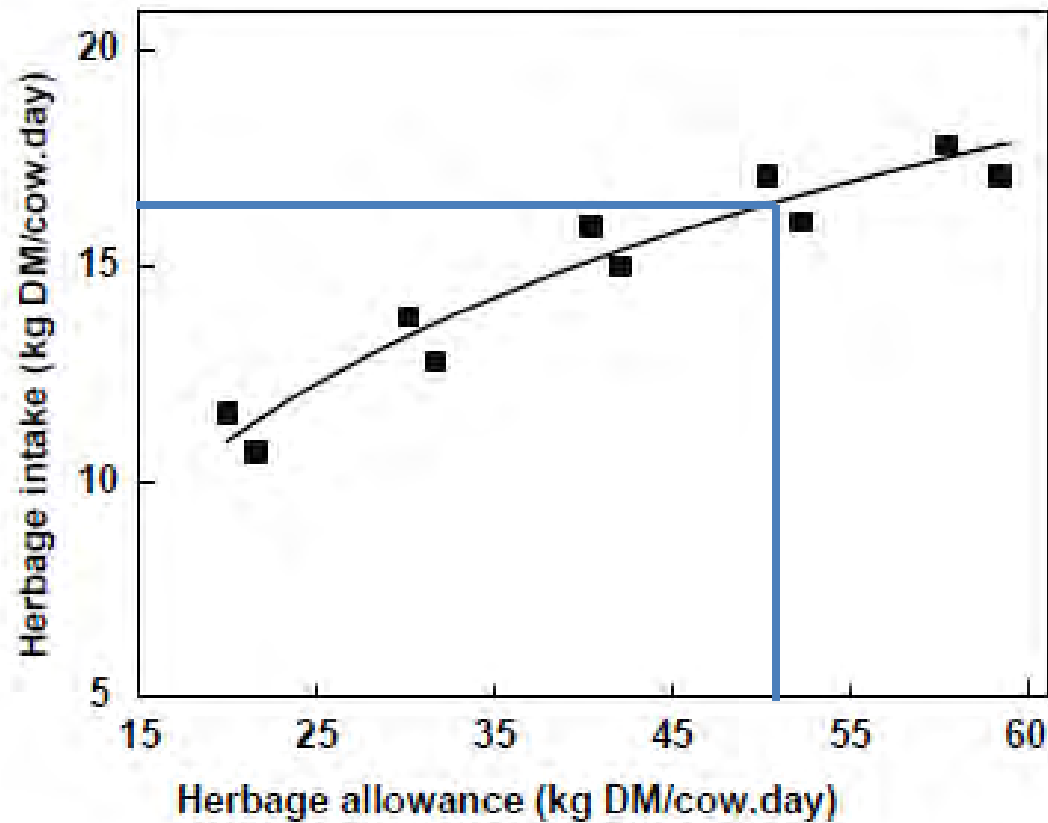


Figure 1. Relationship between herbage allowance and estimated dry matter intake of cows grazing rainfed perennial pastures in spring.

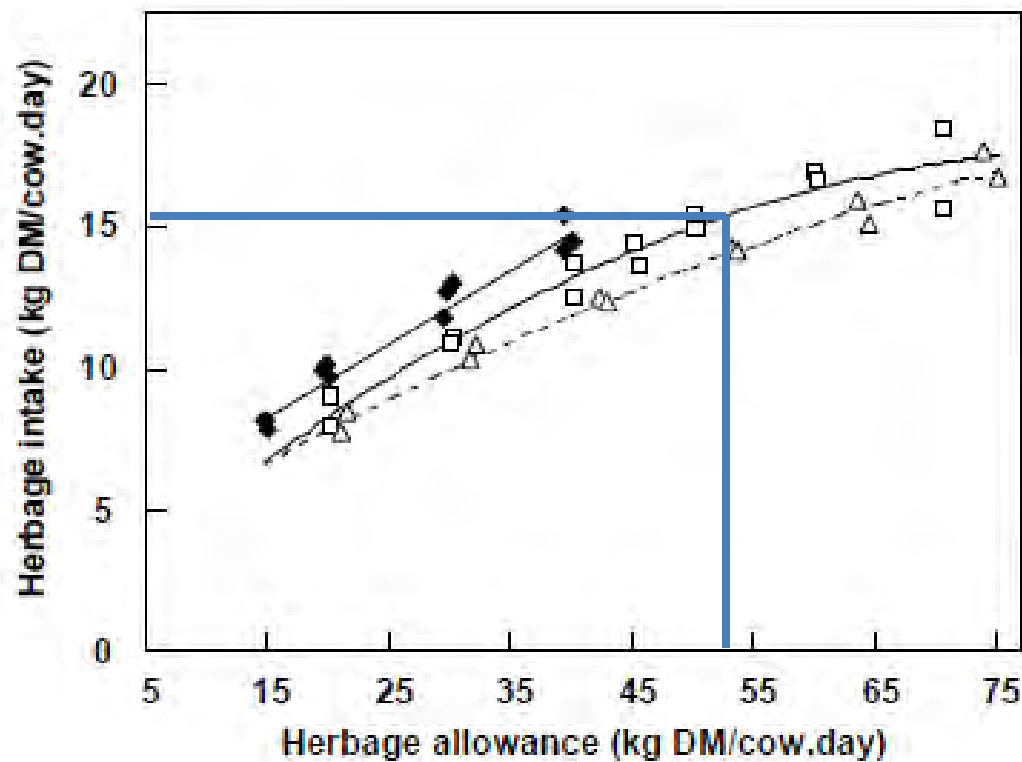


Figure 1. Relationships between herbage allowance and dry matter intake by cows grazing irrigated ryegrass-white clover (●), high mass paspalum-dominant (□) and medium mass paspalum-dominant (△) pastures.

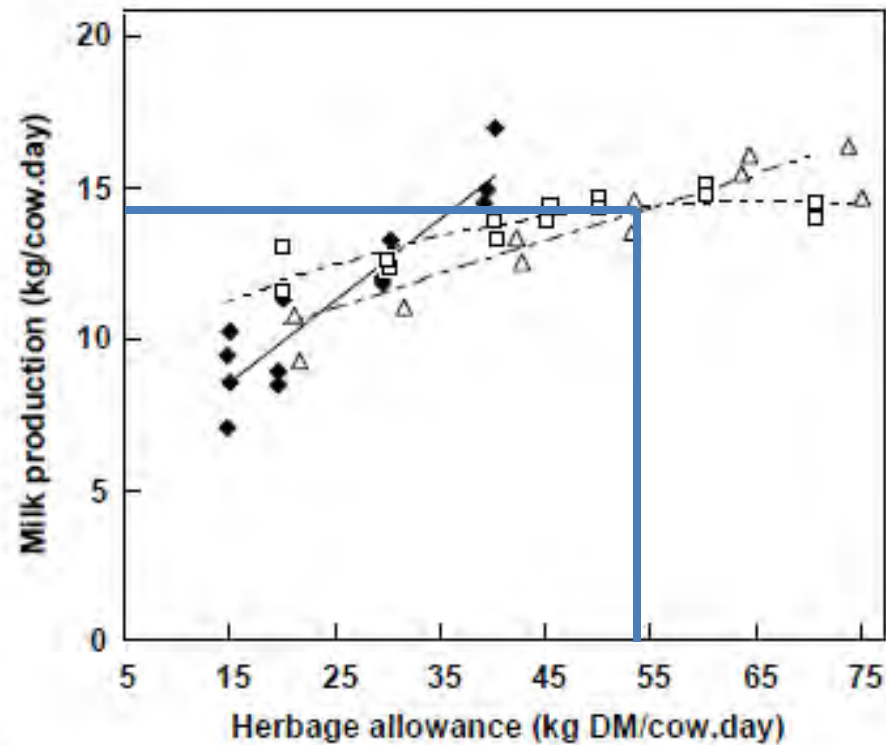


Figure 2. Relationships between herbage allowance and milk production by cows grazing irrigated ryegrass-white clover (◆), high mass paspalum-dominant (□) and medium mass paspalum-dominant (△) pastures.

Sooo...Does this Work?

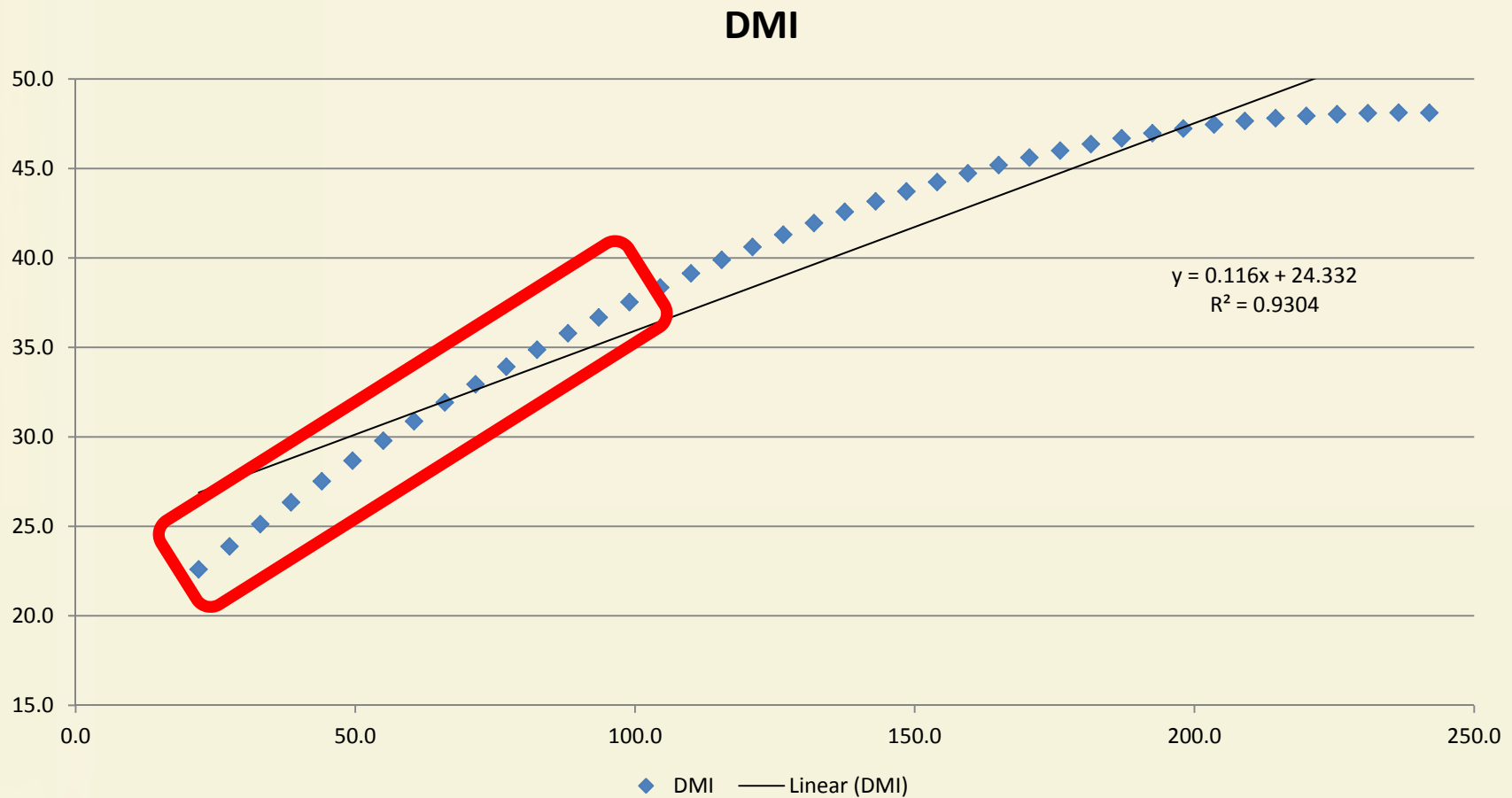
- High pasture allowance (unrestricted pasture) yields:
 - Low utilization (<50%)
 - Deterioration of pasture quality



Suggested Pasture Allowance

- Unrestricted pasture allowance still yielded DMI of 5-8#/cow/day less DMI than TMR counterparts thus milk yield
- Recommendation to provide 2 times desired DMI
- Or 55#/cow when feeding supplements (Bargo et al)

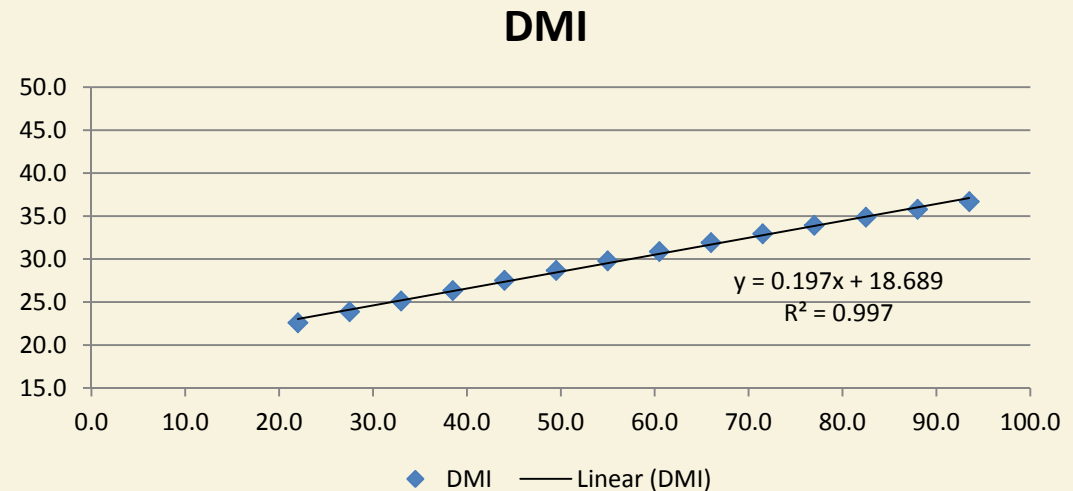
Bargo et al Equation



Intake and Allocations?

offer intake "X" allocation

25	23.6	1.1
30	24.6	1.2
35	25.6	1.4
40	26.6	1.5
45	27.6	1.6
50	28.5	1.8
55	29.5	1.9
60	30.5	2.0
65	31.5	2.1
70	32.5	2.2



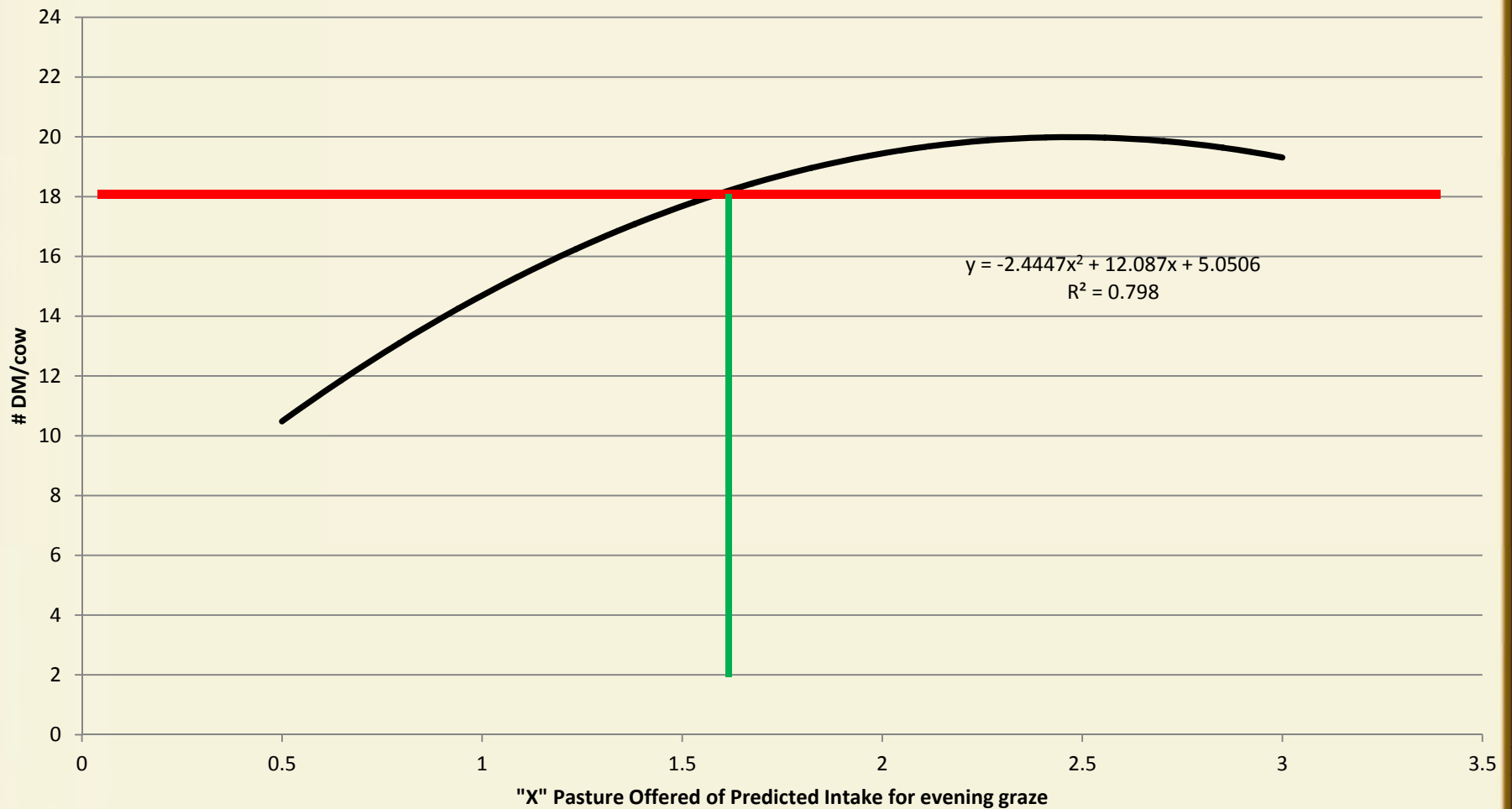
Just a suggested method

$$\text{Intake} = 0.2 * \text{allocation/cow} + 18$$

Demonstration of Allocation Area on Pasture Intake



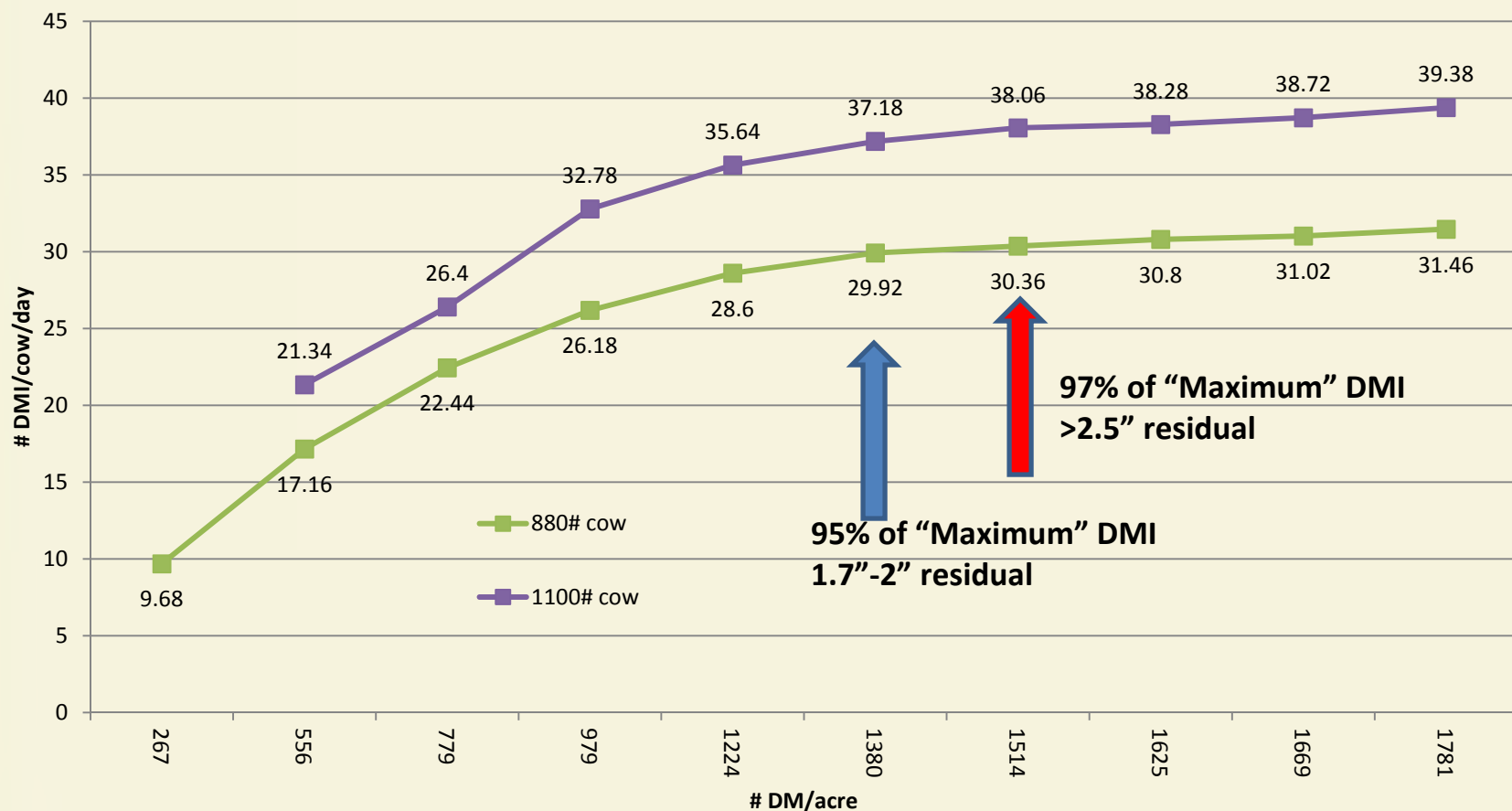
Comparison of "50-300%" of Predicted DMI



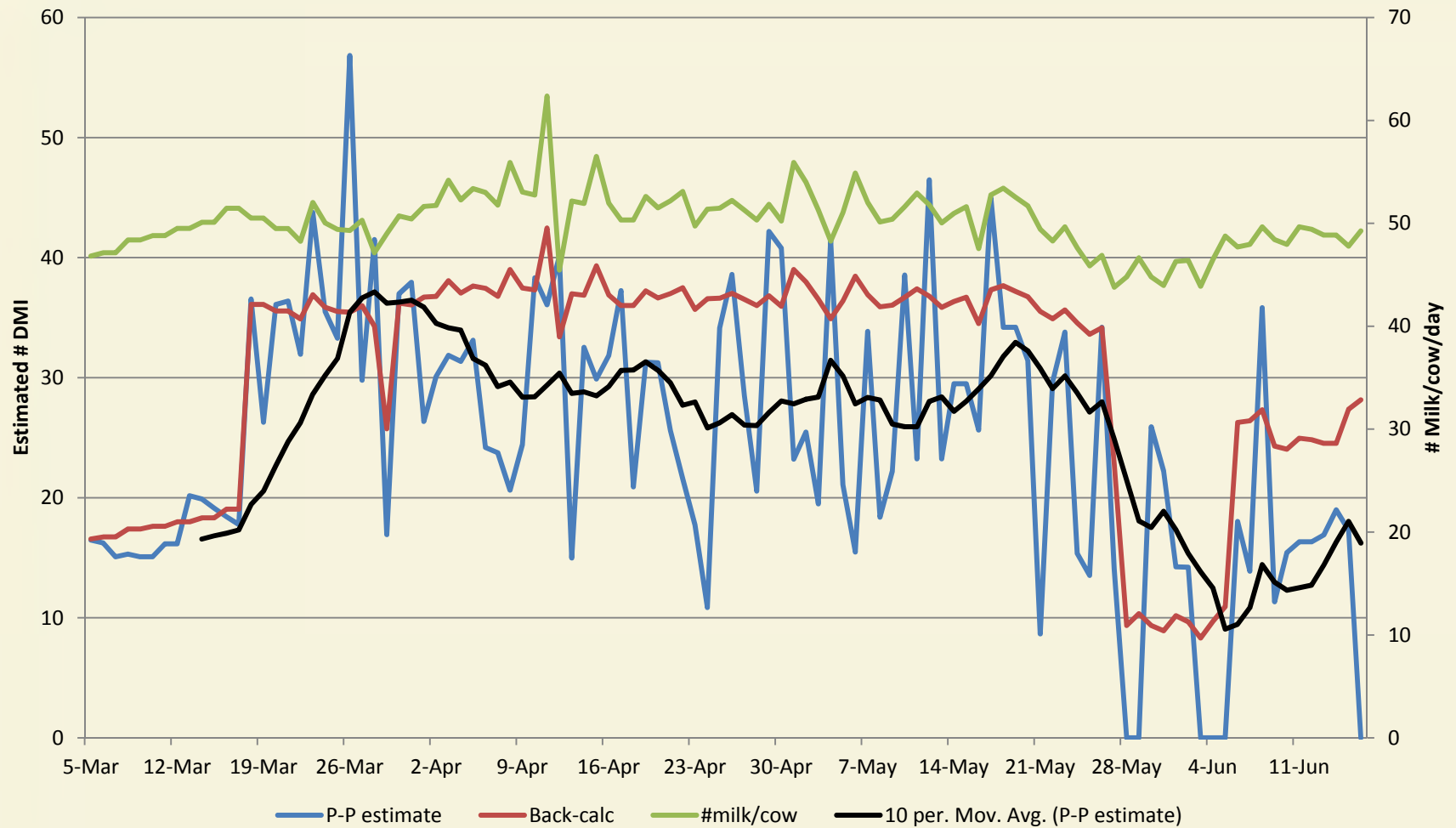
DM/cow — Poly. (# DM/cow)



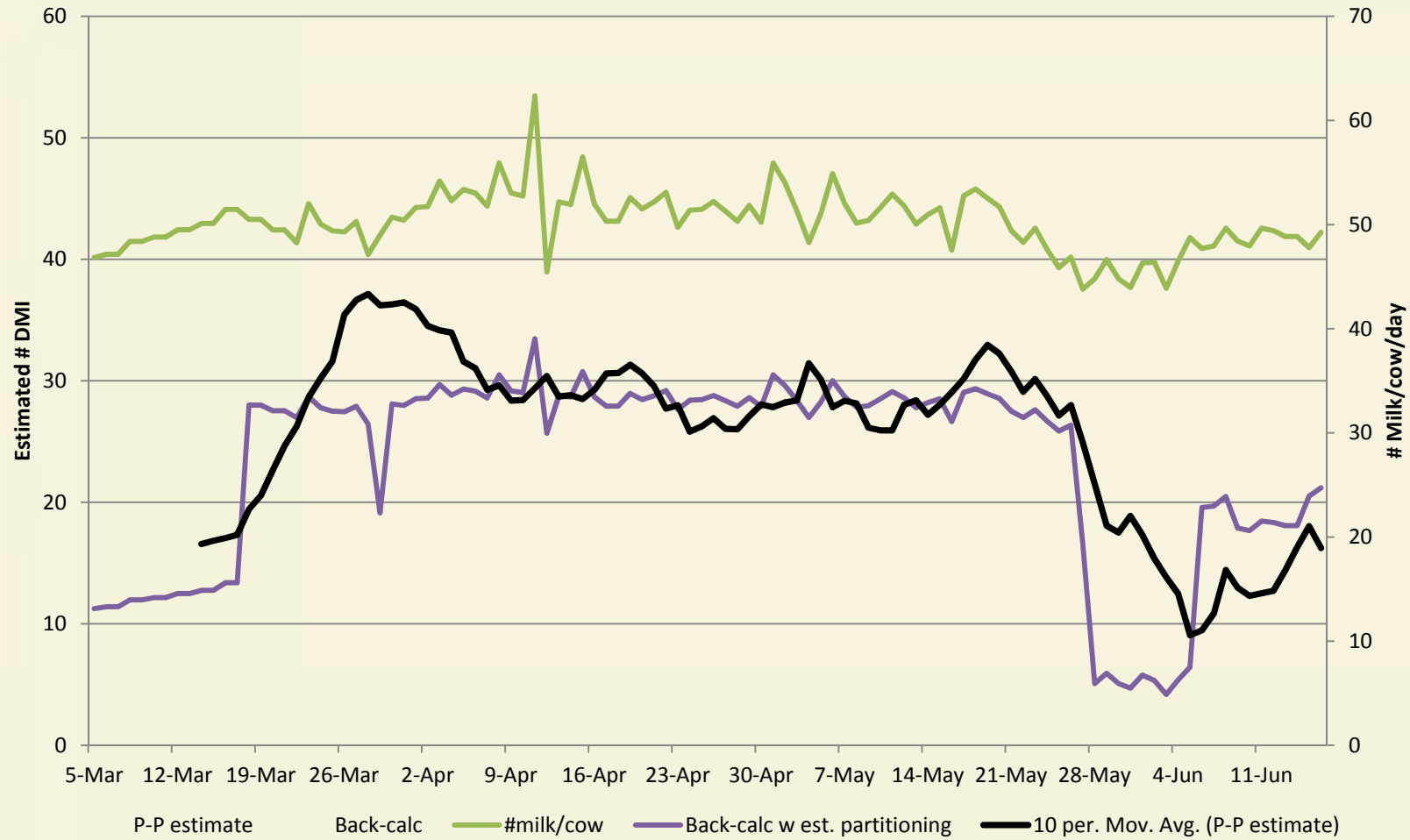
Grazing Residual and Herbage Intake



MU SWC Dairy Estimated Intake and Milk Production 2011 YTD



MU SWC Dairy Estimated Intake and Milk Production 2011 YTD



Genetic Differences on Substitution Rate on Intake

- Sheahan et al suggest genetic/strain difference in substitution rate and milk response

	S.R.	DMI	# milk
• New Zealand			
– Early lactation	0.45	40.5	56.2
– Mid lactation	0.72	39.8	45.7
– Late lactation	0.48	39.9	35.0
• U.S.			
– Early lactation	0.29	42.5	64.7
– Mid lactation	0.26	47.3	55.4
– Late lactation	0.17	46.6	43.0
• Milk response rate (6.6 and 13.2 grain levels)			
– New Zealand	0.8 and 0.7	# milk/# grain	
– U.S	1.9 and 1.1	# milk/# grain	

Summary:

Allocation of Pasture is Doubled Edged Sword

- Too much results in:
 - Well fed cows
 - Poor pasture quality
 - Potential lost milk and pasture yield
- Too little results in:
 - Hungry cows
 - Excellent pasture quality
 - Potential lost milk but increased pasture yield
- Have to balance out the good, the bad and the ugly!

Conclusion-Summary

- Reduced pasture intake is main reason for lower milk production
- Dry matter offered will determine overall pasture DMI
 - Balancing act between pre-grazing and desired post graze
- Offer 1.5-2 X of desired pasture intake
 - Monitor to ensure getting intakes desired
 - >30# DM pasture is achievable
 - Fiber will have limited effect on intake in well managed systems
 - Quality will have some impact on DMI due to neuropeptides
 - Be aware of forage quality and plant health throughout

