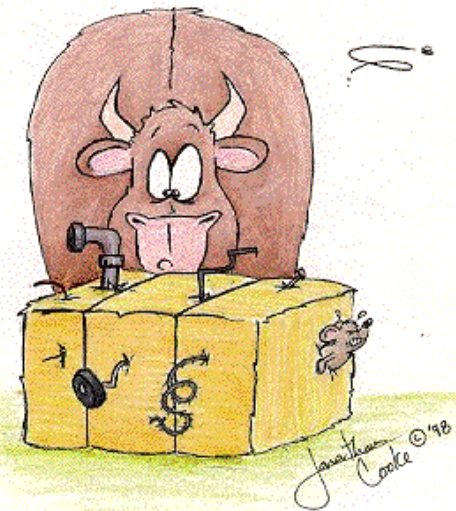
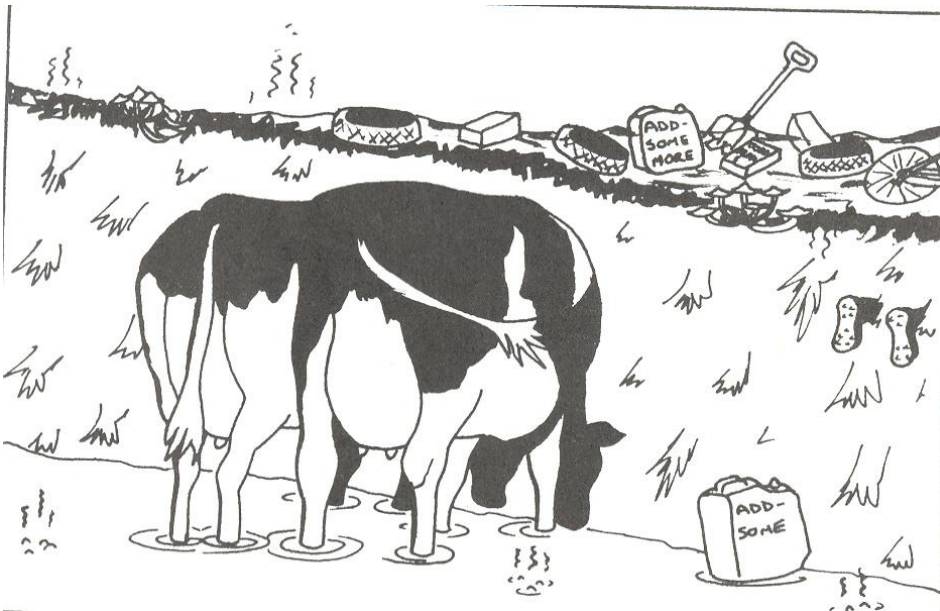


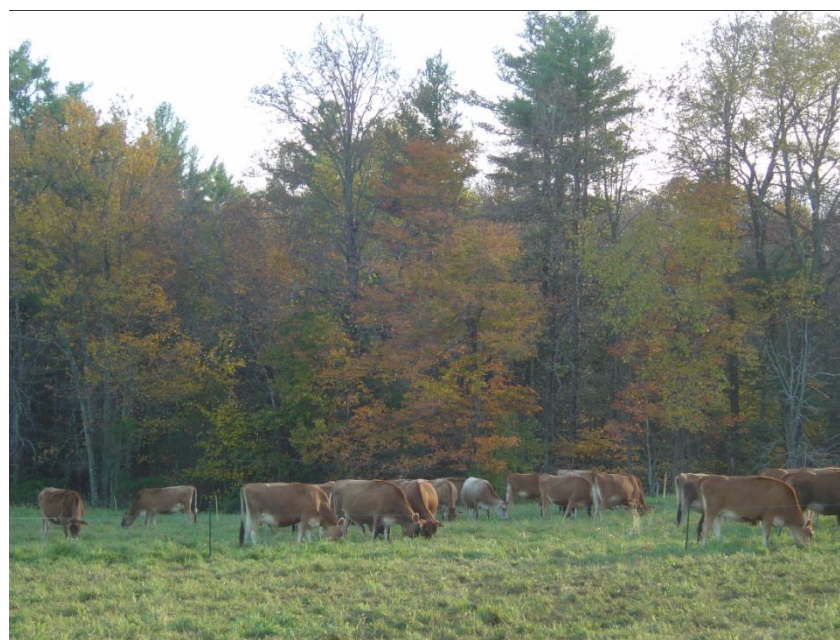
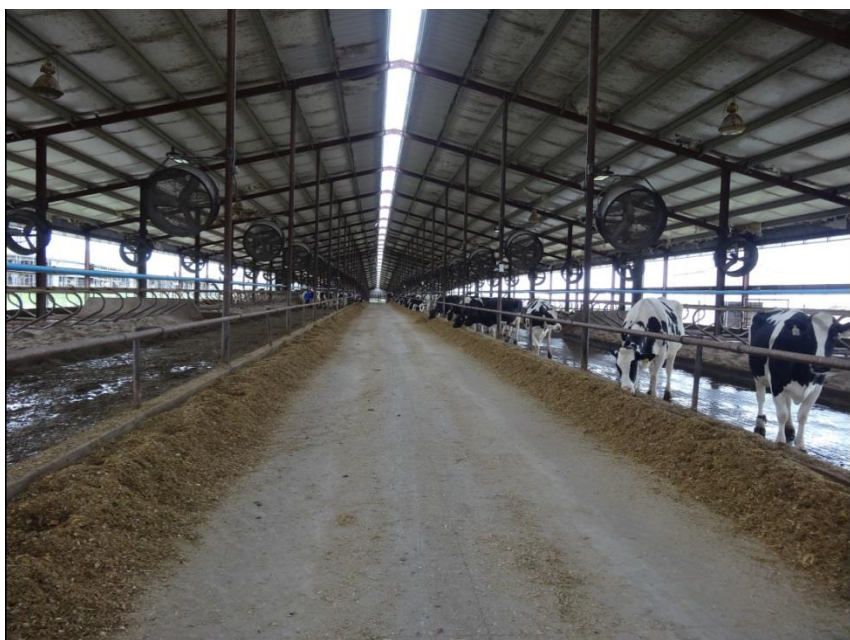
Managing forages for the modern dairy cow

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How much forage can we feed to modern dairy cows?

- The real question is: How much forage can we feed economically to modern dairy cows?



Examples of high-forage diets in northeastern U.S.

Item	Herd 1	Herd 2	Herd 3	Herd 4	Herd 5	Herd 6
Milk, lb./day	91	88	105	90	76	100
Milk fat, %	3.8	4.3	3.8	4.0	3.8	3.6
Milk true protein, %	3.10	3.10	3.10	3.25	3.15	2.90
Ration starch, % DM	27	24	26	24	24	24
Ration crude protein, % DM	15.5	15.7	18.3	17.3	16.3	17.2
Ration NDF, % DM	32.7	33.3	32.7	30.8	34.4	32.0
Forage NDF, % bodyweight	1.0	1.1	1.0	0.9	1.0	1.0
Forage, % of ration DM	65	64	62	70	75	62
Corn silage, % of forage DM	66	36	56*	60	61	56
Alfalfa silage, % of forage DM	34	0	29	0	0	40
Legume/grass forage, % forage DM	0	64	15	40	0	0
Grass silage, % forage DM	0	0	0	0	39	4

*BMR corn silage.

DM = dry matter.

Adapted from Chase and Grant (2013).

Energy corrected milk

$$\text{ECM} = 0.327 \times \text{milk pounds} + 12.95 \times \text{fat pounds} + 7.2 \times \text{protein pounds}$$

The energy-corrected milk equation

Item	Herd					
	1	2	3	4	5	6
Milk, lbs/d	91	88	105	90	76	100
ECM, lbs/d	95	97	109	97	79	100
Milk price \$/Hl	74.17	79.36*	74.17	77.42*	74.56	70.54
Gross income, \$/cow/d	30.68	33.52	35.40	33.40	25.76	32.06

* Premium for the SNF/FAT ratio in milk

How much milk comes from forages?

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The milk from forage concept?



Milk from forage

- Developed in the 70's at Université Laval
- Milk from forage (MF) = estimation of the milk produced from forages by subtracting milk production theoretically allowed by concentrates.

Milk from forage - How to calculate it?-

$$MF_{\text{average}} = (MF_{\text{energy}} + MF_{\text{protein}}) / 2$$

$$MF_{\text{energy}} = ECM - \frac{[\text{Conc } NE_L \text{ (Mcal)} - NE_L \text{ for growth (Mcal)}]}{0.75 \text{ (Mcal/kg milk)}}$$

$$MF_{\text{protein}} = PCM - \frac{[\text{Conc } CP \text{ (kg)} - CP \text{ for growth (kg)}]}{0.088 \text{ (kg CP/kg of milk)}}$$

Milk from forage

- How to calculate it? -

Simplified method:

$$\begin{aligned} \text{Milk concentrates} = & \text{Commercial mix (kg AF)} && \times 1.0 \\ & + \text{Corn grain, dry (kg AF)} && \times 0.8 \\ & + \text{Corn grain, hi-must (kg AF)} && \times 0.7 \\ & + \text{Small grain (kg AF)} && \times 0.9 \\ & + \text{Commercial supplement (kg AF)} && \times 1.7 \\ & + \text{Soybean meal (kg AF)} && \times 2.0 \\ & - (\text{Mature weight(kg)} \times \text{cows nb} \times \text{culling rate} \times 0.55) \end{aligned}$$

$$\text{MF(kg)} = \frac{[\text{Milk(kg)} - (\text{Milk concentrates(kg AF)} \times 2)]}{\text{Cows number}}$$

Milk from forage - How? -

Milk from forage objectives (kg/cow)

Average cow weigh (kg)	Acceptable Level	Treshold
> 650	2700	3400
550 to 650	2600	3200
< 550	2500	3000

Milk from forage

	Average	20% Higher MF	20% Lower MF
Number of farms	672	134	134
Herd size	79	65	101
Forages (Ha)	78.1	70.2	88.9
yield (TDM/Ha)	6.3	6.3	6.5
cost (\$/TDM)	230	245	213
Corn silage (Ha)	13.2	10.4	19.4
yield (TDM/Ha)	12.3	12.5	12.5
cost (\$/TDM)	194	198	189
Milk (HI)	7046	5983	8948
Milk (Kg/cow)	9017	9353	8646
MF (Kg/cow)	3111	4977	1226
Net income (\$/cow)	1393	1835	1032

Milk from forage with corn silage

	Average	20% Higher	20% Lower
Number of farms	444	89	89
Herd size	91	69	121
Forages (Ha)	76.2	59.7	93.3
yield (TDM/Ha)	6.9	6.9	7.0
cost (\$/TDM)	229	243	217
Corn silage (Ha)	19.9	15.5	27.5
yield (TDM/Ha)	12.3	12.5	12.5
cost (\$/TDM)	194	198	189
Milk (HI)	8360	6524	11021
Milk (Kg/cow)	9368	9675	8990
MF (Kg/cow)	3092	5022	1161
Net income (\$/cow)	1420	1792	1068

Milk from forage without corn silage

	Average	20% Higher	20% Lower
Number of farms	228	45	45
Herd size	54	59	53
Forages (Ha)	82.0	91.7	82.4
yield (TDM/Ha)	5.1	5.1	4.7
cost (\$/TDM)	233	248	217
Corn silage (Ha)			
Milk (HI)	4392	4936	3994
Milk (Kg/cow)	8320	8690	7713
Forage Milk (Kg/cow)	3157	4886	1381
Net income	1322	1976	792

Conclusions

- Producing more milk from forage will not reduce rolling herd average.
- MF is higher with corn silage... but net income /cow is not:
 - With corn silage = 1792 \$/cow
 - Without corn silage = 1976 \$/cow
- Corn silage = larger farms (91 vs 54 cows)
- Can we make haycrop silage more appealing to larger farms?
- Why such a difference between the top and bottom 20% ?

Why?

	0 - 20	21 - 40	41 - 60	61 - 80	81 - 100
Milk/cow	7675	8747	9340	9925	10871
Forage milk/cow	2709	3156	3451	3863	4163
Total intake, % Lwt	1.76	2.15	2.43	2.40	2.86
Forage intake, % Lwt	1.21	1.44	1.63	1.64	1.90
	Kg DM/cow/year				
Corn silage	655	950	1056	1502	1513
Haycrop silage	3028	3140	3112	3060	2978
Hay	712	638	630	558	594
Pasture	88	68	44	11	14
Other	233	217	289	285	415
Total forage	4715	5013	5132	5416	5514
Concentrates	2209	2426	2480	2533	2769

How do they do it?

- Herds with more MF feed more forages
 - Forage quality?
 - Forage availability?
 - Substitution by cows? (associative effects)
- Herds with more MF do not feed less concentrates

Milk from forage *- Concentrate amount -*

■ Objective:

- Long term comparison of production performances of cows receiving more concentrates

■ Methods

- Split a herd in 2 equivalent halves over a 2 year-period
- Feed first half of the cows for 9000 Kg milk and the other half for 7000 kg according to NRC89.

Milk from forage

- Concentrate amount, results -

- Cows receiving low concentrates diet
 - Ate 1000 kg ↓ concentrates per lactation
 - ↑ their forage intake by 24%
 - Targeted difference of 2000 kg per lactation between groups could not be met
 - None significant differences in milk production (585kg for primarous and 357 kg for multiparous)
 - No difference in milk composition
- Except a ↑ MUN for multiparous with low concentrate ration

Milk from forage

- Concentrate amount, conclusion -

- Production performances maybe more related to concentrates type than amount.

Milk from forage

- Concentrate type, objectives -

- Establish which type of concentrates optimizes the production of MF when using alfalfa silage-based diets.
- Establish which type of concentrates optimizes the production of MF when corn silage-based rations are used.



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Milk from forage

- Concentrate type, hypothesis -

Alfalfa silage trial

- With alfalfa silage, increasing the rumen degradability of carbohydrates (CD) in concentrates should lead to a better use of RDP in forages

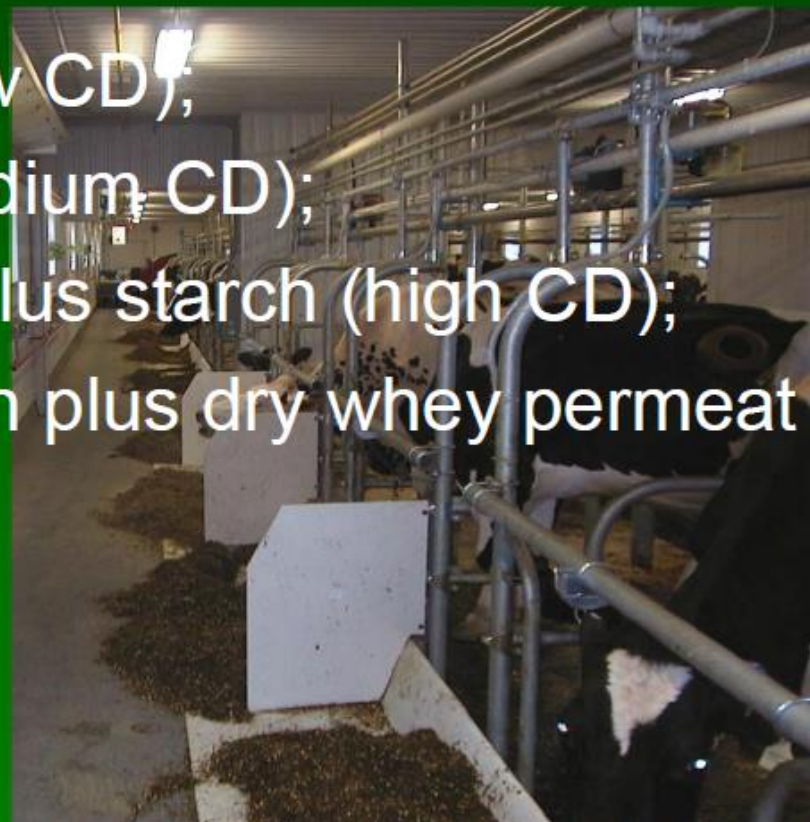
Corn silage trial

- Increasing the RDP content in corn silage-based diet should allow a better utilization of energy from the forage.
- Increasing carbohydrate degradability (CD) by corn grinding should allow a better use of RDP from concentrates.

Trial with alfalfa silage

■ Treatments:

- 1) Ctrl- cracked corn (low CD);
- 2) GC- ground corn (medium CD);
- 3) Starch- ground corn plus starch (high CD);
- 4) Permeat - ground corn plus dry whey permeate (high CD).



Trial with alfalfa haylage

- Production performance results

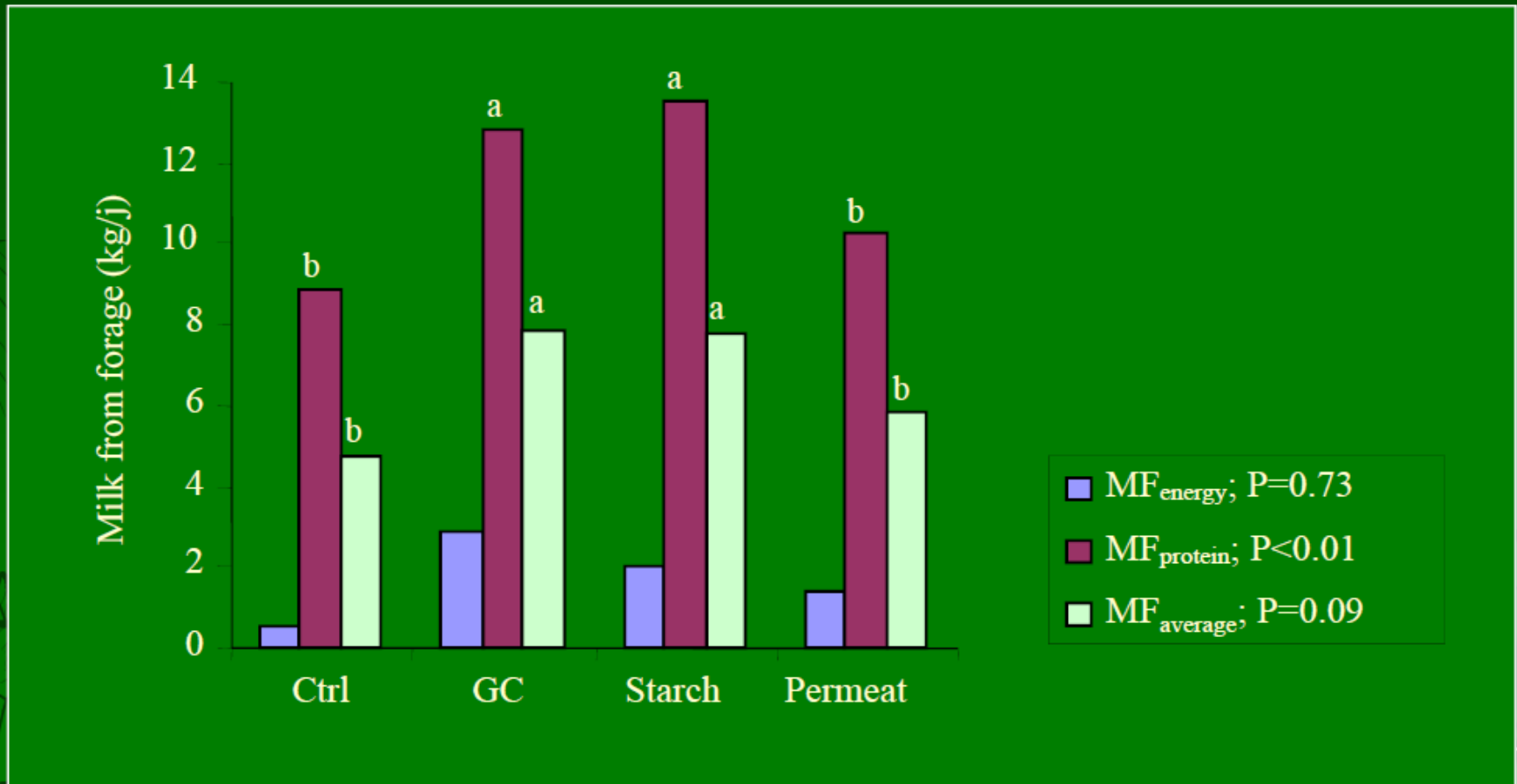
	Ctrl	GC	Starch	Whey permeat	<i>P</i>
Milk (kg)	34.0 ^c	37.4 ^{ab}	37.6 ^a	35.8 ^b	<0.01
Fat (%)	3.82 ^{ab}	3.55 ^{ab}	3.49 ^b	3.88 ^a	0.08
Prot. (%)	3.22	3.33	3.33	3.35	0.14
MUN (mg/dl)	13.4 ^a	10.7 ^b	9.9 ^b	9.8 ^b	<0.001



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Trial with alfalfa haylage

. Effect of CD on milk from forage (MF).



Trial with alfalfa haylage Summary –

•GC and Starch

- \uparrow MF_{protein} and MF_{average}
- \uparrow Milk yield
- Intermediate intake



•Permeat

- Milk from forage intermediate
- Milk yield intermediate
- \uparrow intake



•Ctrl (Craked corn)

- \downarrow Milk yield
- \downarrow Intake



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Corn silage trial

- Four treatments :

- 1) 85-CC:Cracked corn based diet providing 85% of NRC 2001 RDP req.;
- 2) 100-CC:Cracked corn based diet providing 100% of NRC 2001 RDP req.;
- 3) 115-CC:Cracked corn based diet providing 115% of NRC 2001 RDP req.;
- 4) 115-GC:Ground corn based diet providing 115% of NRC 2001 RDP req.;

Corn silage trial - Summary

■ Increasing RDP, with cracked corn

- ↓ MF_{protein}
- ↓ Milk yield
- ↑ Milk Fat concentration

■ Lower levels of RDP were sufficient for milk production.



■ Ground vs. cracked corn with high level of RDP

- ↑ MF_{protein}
- ↑ Milk yield
- ↓ Milk Fat concentration
- ↑ Milk Protein concentration

■ With the highest level of RDP, grinding corn resulted in better performances.

Milk from forage - Conclusions -

- To increase Milk from forage
 - Good quality forages
- But not enough, have to use them...
 - Increase forage intake \Rightarrow DMI
 - Adequate amount of concentrates for each cow \Rightarrow Multi-groups TMR
 - Adequate choice of concentrates for the actual forages (type, processing,...)



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Forages for the modern dairy cow

- To increase milk from forage we need to:
 - Produce high quality forages
 - Let the cows eat as much forage as possible
 - Complement forages with appropriately processed concentrates.