Feeding small grains and small grain silages

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Why do I like small grains for the Northeast?

"Opportunity to reward good management"

Flexibility in harvest, storage and feeding options

Competitiveness of the crop

Utilization of "winter" growing season


<u>Complementing grain</u>

with ***Quality*** forages

Excess protein costs in…

- Use of energy for excretion of surplus N from soluble and NPN sources
- Potentially detrimental to reproductive performance
- Utilize MUN (Milk Urea Nitrogen) or BUN (Blood Urea Nitrogen) as a monitor

Table I. Nutrient composition of common feed grains and oilseeds.

	Corn	Sorghum	Wheat	Oats	Barley	Soybeans	Cottonseed
	(% of Dry Matter)						
Crude protein	10.0	9.7	16.0	13.3	13.5	42.8	23.0
NE_L, Mcal/pound[1]	.89	.84	.89	.80	.88	.96	1.01
Fat	4.3	3.4	2.0	5.4	2.1	20.0	20.0
NDF	9.0	18.0	14.0	32.0	19.0	14.0	44.0
Ca	.03	.04	.04	.07	.05	.49	.21
P	.29	.34	.42	.38	.38	.21	.64

Source: National Research Council (1989).

[1]NE_L = Net energy for lactation.

FEEDSTUFF	MODAL VALUE AND RANGE	
	Starch	Crude Protein
	---- % of Dry Matter ----	
Corn grain	72 (65-76)	10.0 (9.3-10.1)
Sorghum grain	72 (68-80)	10.5 (9.5-12.0)
Wheat grain	77 (66-82)	14
Barley grain	57 (55-74)	12.0 (10.0-19.5)
Oats grain	58 (45-69)	12.6 (12.5-12.8)

Extent of Starch Digestion in the Rumen

- Grain type (ex. corn vs barley)
- Processing
- Other components of the diet (complements?)
- Passage rate through the rumen

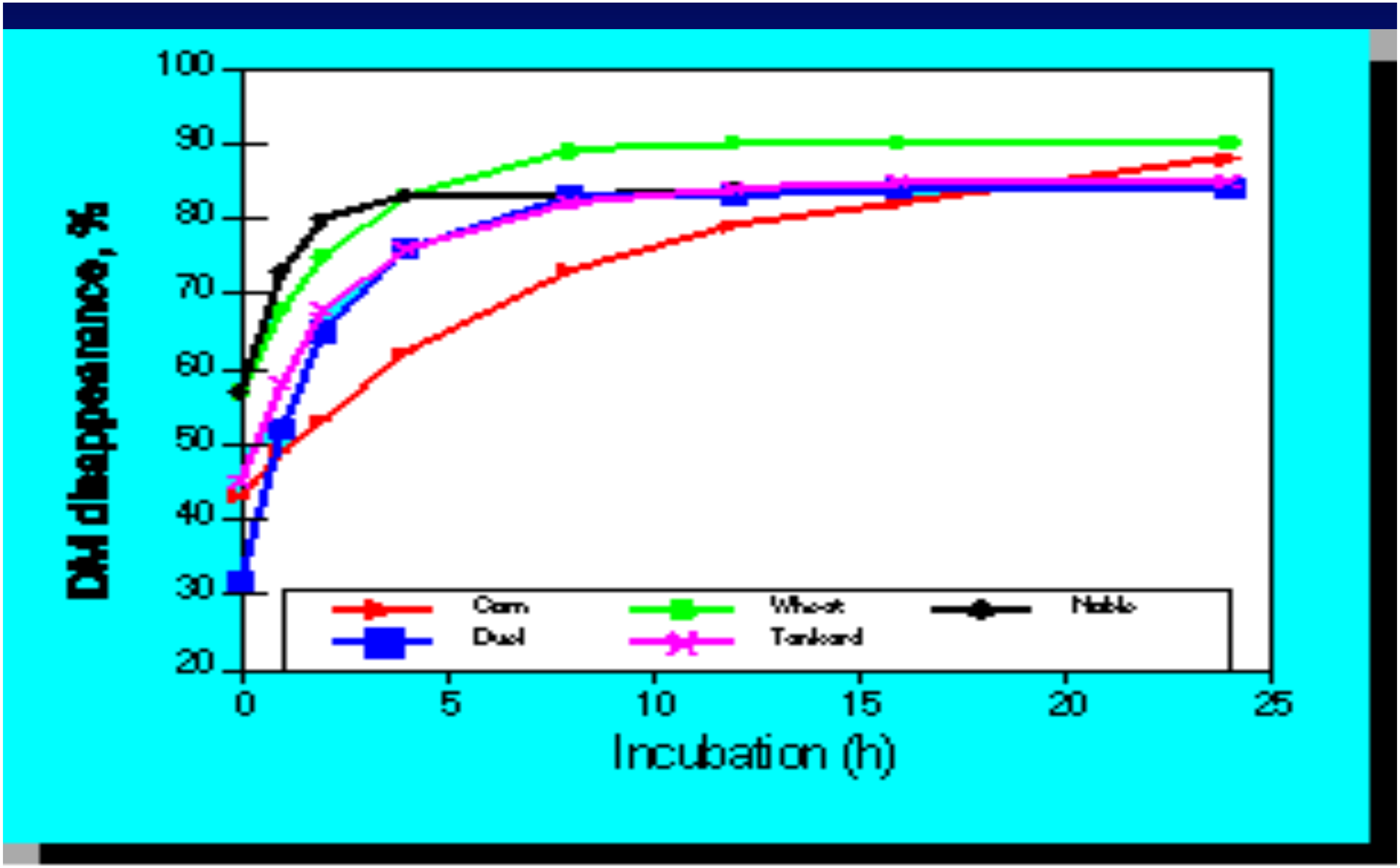
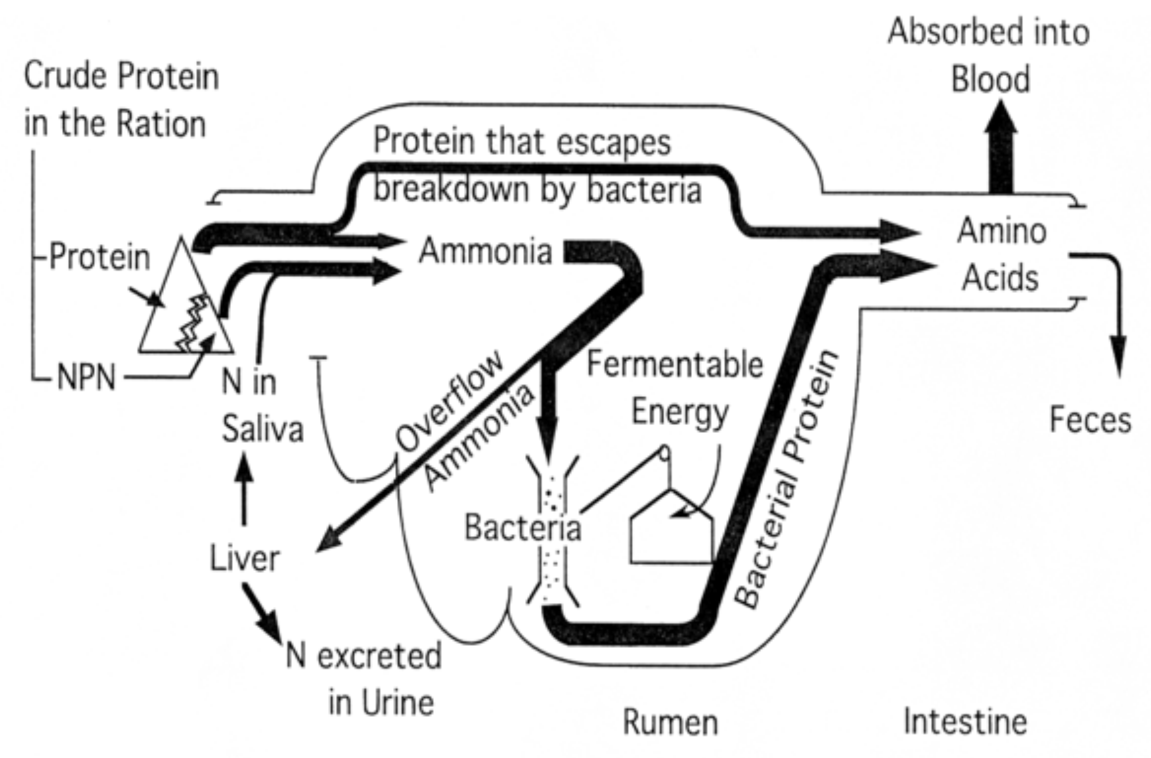


Figure 4. Comparison of in situ degradation kinetics for corn, wheat, and barley cultivars.

Protein Primer

- Soluble
- Degradable
- NPN
- Undegradable
- By-Pass
- Microbial
- Metabolizable

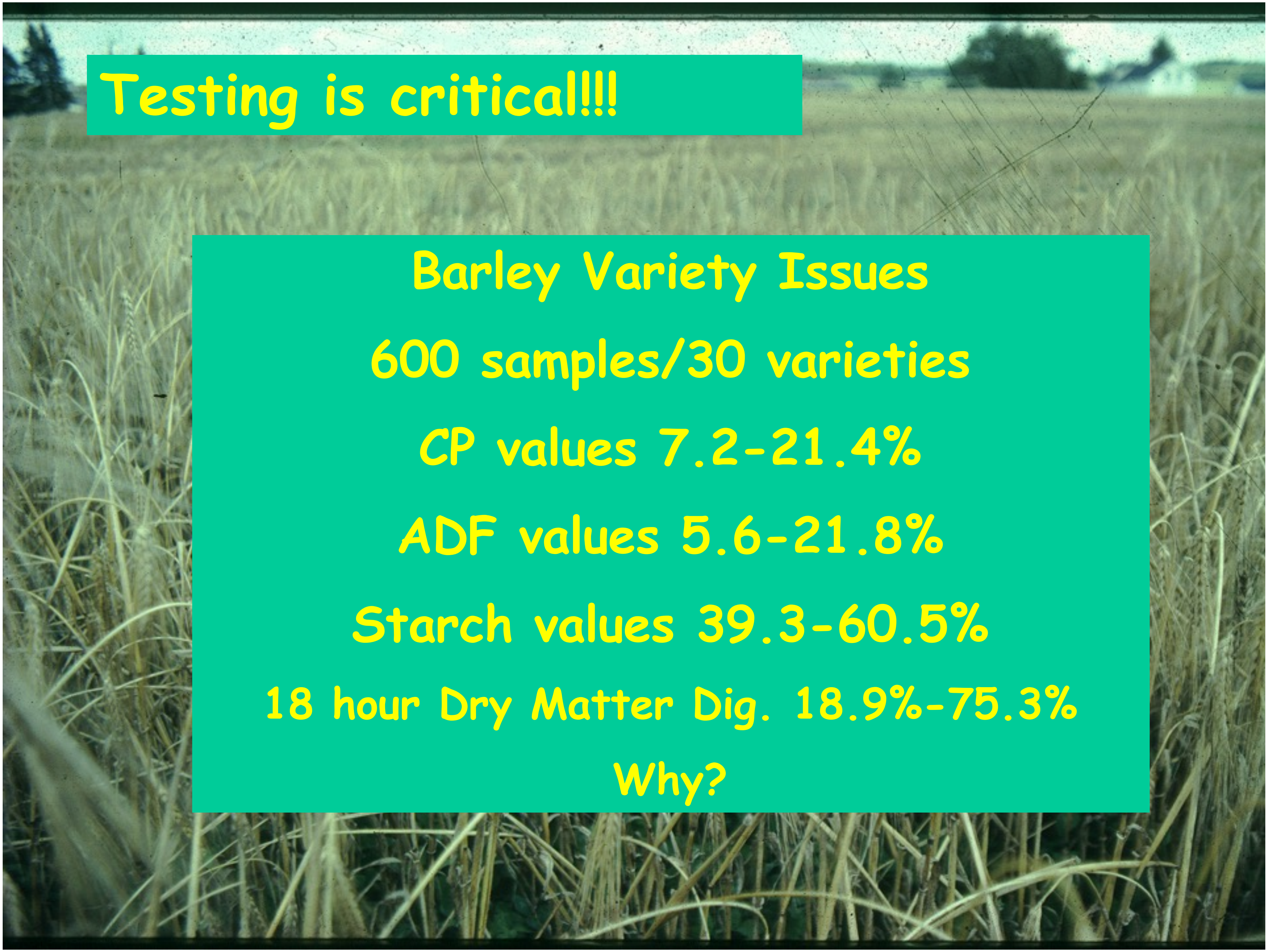


Schematic summary of nitrogen utilization by the dairy cow and other ruminants.
(Courtesy of L. D. Satter)

	McCarthy et al.[17]		Overton et al.[23]	
	BARLEY	CORN	BARLEY	CORN
Dry Matter Intake, kg/day[a]	21	24	20	23
Starch Intake, kg/day[a]	8.4	10.6	6.7	7.5
Apparently digested in rumen, kg/day[a]	6.5	5.2	5.0	3.2
intake[a] ....% of starch	77.0	49.2	74.4	41.9
Passage to Duodenum, kg/day[a]	1.9	5.4	1.7	4.3
Apparently digested postruminally, kg/day[a]	1.6	4.7	1.4	3.6
........% of starch intake[a]	19.7	44.0	21.8	49.0
Apparently digested in the total digestive tract, % of starch intake[a]	96.8	93.2	96.2	90.8
[a]Means differ significantly (P<0.01) between corn and barley.				

Table 2: Ruminal and postruminal digestion of barley and corn starch in lactating dairy cows.

- The Cornell Net Carbohydrate and Protein System (CNCPS) was developed to predict requirements, feed utilization, animal performance and nutrient excretion for dairy and beef cattle and sheep, using accumulated knowledge about feed composition, digestion, and metabolism in supplying nutrients to meet requirements.


Testing is critical!!!
Barley Variety Issues
600 samples/30 varieties
CP values 7.2-21.4%
ADF values 5.6-21.8%
Starch values 39.3-60.5%
18 hour Dry Matter Dig. 18.9%-75.3%
Why?

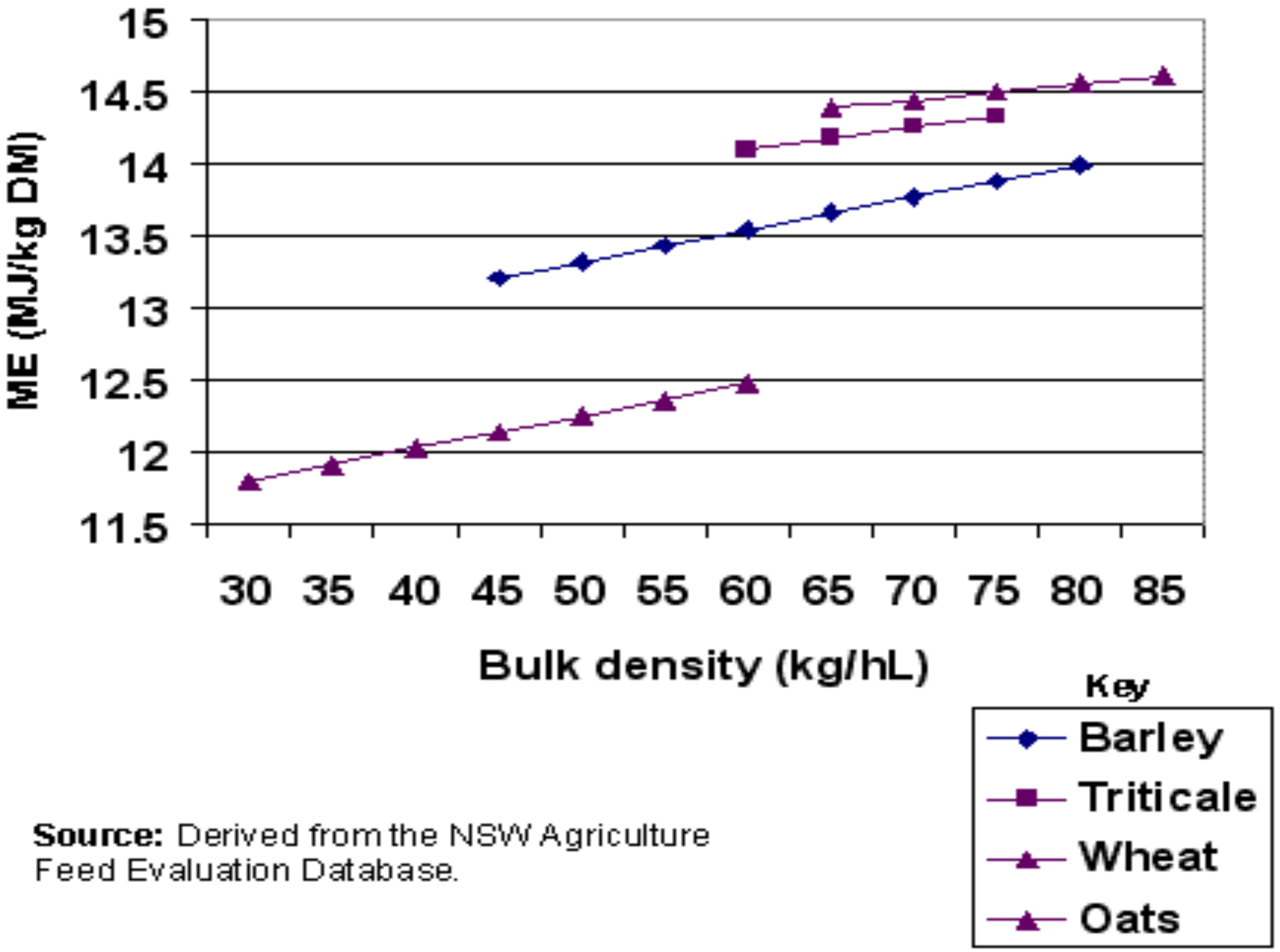
Why the differences

- Malting lottery....
- Nitrogen management
- Test Weight (Buy whole grains!)
- Processing (roast, grind, temper, roll)
- Storage

Feeding considerations

- How much can you feed?
- What do feed with the grain?
- How is it processed?
- How often will you feed the grain?
- What is your production goal?
- Know your grains and specific characteristics….
- Watch your cows

Relationships between the bulk density of grains and their metabolisable energy (ME) content



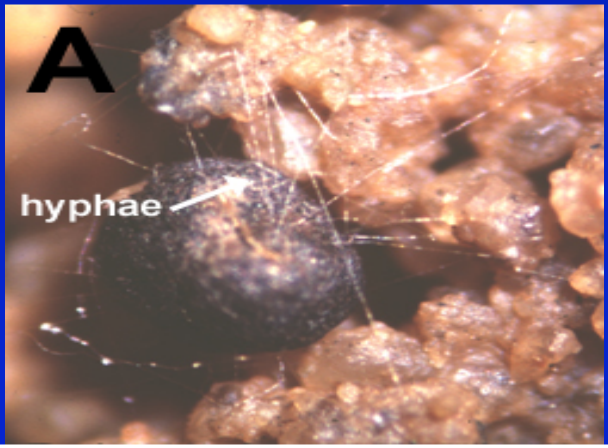
Source: Derived from the NSW Agriculture Feed Evaluation Database.

Processing Small Grains

- Grinding (hammermill)
- Rolling
- Steam flaking
- Roasting
- Tempering

Quality Considerations for Dairy Cattle

- Grain molds in the field
- Low test weight (reduces energy content of grain 5-10%)
- Damaged or broken kernels
- Sprout damage
- Immature grain
- Heat damage
- Improper moisture content



Vomitoxin

Advisory levels for vomitoxin (DON) in livestock feed

Class of Animal	Feed Ingredients & Portion of Diet	DON Levels in Grains & Grain By-products and (Finished Feed)
Ruminating beef and feedlot cattle older than 4 months	Grain and grain by-products not to exceed 50% of the diet	10 ppm (5 ppm)
Chickens	Grain and grain by-products not to exceed 50% of the diet	10 ppm (5 ppm)
Swine	Grain and grain by-products not to exceed 20% of the diet	5 ppm(1 ppm)
All other animals	Grain and grain by-products not to exceed 40% of the diet	5 ppm (2 ppm)

Source: Mycotoxins in Feeds: CVM's Perspective, presentation to Risk Management Agency (August 23, 2006 by Michael H. Henry, Ph.D., FDA, CVM
http://www.fda.gov/AnimalVeterinary/Products/AnimalFoodFeeds/Contaminants/ucm050974.htm

Effects of Tempered Barley on Milk Yield, Intake and Digestion Kinetics of Lactating Holstein Cows.
Christen ,et al.

- Barley tempered by adding 10% water 24 h before rolling was compared to dry rolled barley.
- Tempered rolled barley had a slower rate of passage (7.8%/h) than dry rolled (8.6%/H).
- 21% for dry barley and 6% for tempered washout rate from in situ bag indicates tempering reduced pool size of small particles
- Milk yields increased 5% Digestibility of dietary DM 6%,NDF 15%, ADF 12% CP 10%
- no total intake differences

A Farmer's Actual Experience

- **Perry Lilley, Lilley Farms, Smyrna, ME**
  - On-farm integrated dairy
  - Grows soybeans and small grains for feed
  - Also coupled with a local potato farm


Automatic

Rewarding on farm management by Value adding nutritional components of purchased inputs

- Processing whole seed allows purchase on greater quality indicators such as test weight
- Time sensitive processes like tempering offer greater nutritional efficiency potential
- Processing effect on nutritional variables like effective NDF

Fodder Systems

- Old idea renewed- started in 1600's
- Australia and New Zealand (arid regions)
- Increased interest in United States due to:
  - Recent droughts/extended dry periods
  - High organic grain prices
  - Fodder viewed as 'easy alternative' to producing high-quality forage
  - Hard-sell marketing by those selling the systems, with some pretty impressive (but not necessarily substantiated) animal production/economic claims

- Are fodder systems feasible and economical for US grazing dairy farms in temperate regions?

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Animal Scientist

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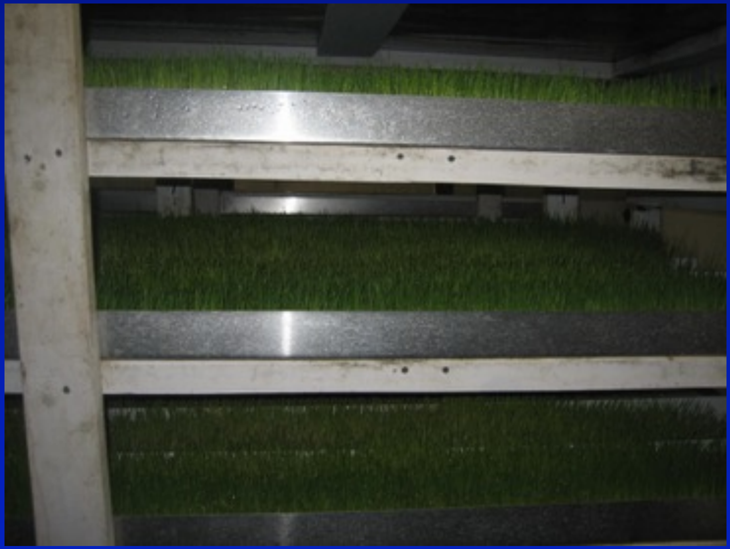
Perceived/Expected Benefits

- Increased palatability
- "Feel-good" feed
- High forage yield in small space
- No pesticides/herbicides
- Little waste
- Low energy/water consumption
- Rapid growth
- "Easy", high-quality forage



www.farmprogress.com

Perceived/Expected Benefits

- Improved nutritional quality
  - Increased vitamins (photosynthesis)
  - Increased minerals (due to water additives)
  - Improved digestibility (starch converted to sugar)
  - Digestive enzymes
  - Fatty acids
  - Improved nutrient availability
  - Reduction in anti-nutritional factors
  - Antioxidant properties

- Consistent feed quality
  - Minimize feed changes from winter to summer
  - Eliminates reliance on weather
  - Molds?

www.offthegridnews.com

- 1 kg grain input, 5-8+ kg output from system (?)

Perceived/Expected Benefits

- Improved animal performance
  - Better heat stress tolerance (high digestibility)
  - Improves digestion/absorption with less energy required
  - Greater milk production, reproduction, weight gain
  - More efficient waste management
  - Immune response
  - Lower SCC
  - Greater vitality/energy

www.fireflyadventures.blogspot.com

- Much lower water requirements than field crops

Potential Drawbacks

- Mold
  - Loss of feed that day- what is the backup plan?
  - Ill/dead animals

- Cost/kg of DM
  - Fodder system distributors don't like to talk about DM

- Labor requirements
- Cows will toss flakes (TMR?)
- Potential for rumen acidosis (sugars)
- Initial capital expense (purchased systems)
- Doesn't qualify for Organic Pasture Rule or some grassfed labels

Nutrient Composition

	Barley Grain	Sprouted Barley	% Change	Pasture
CP, % DM	12.9	14.7	+ 14	25.5
NDF, % DM	14.4	30.5	+ 112	50.0
ADF, % DM	5.30	15.5	+ 193	31.6
Starch, % DM	58.1	27.7	- 52	1.10
ESC, % DM	2.0	15.9	+695%	5.8
WSC, % DM	4.0	21.1	+428%	9.9
Ca, % DM	0.05	0.05	0	0.67
P, % DM	0.43	0.49	+ 14	0.51

Sprouting:

- **Slightly increased CP**
  - **Due to decreased DM**
  - **Concentrates existing CP, does not create more unless there is N in the water**

Hafla et al., 2014

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  * Due to decreased DM
    * Concentrates existing CP, does not create more unless there is N in the water
* Increased fiber (NDF, ADF)
  * Concentration of nutrients
* Decreased starch- converted to sugar
  * May change feed conversion
* Increased sugar (ESC & WSC)

Hafla et al., 2014

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* **Minerals relatively unchanged and will depend on additives in water**

Hafla et al., 2014

Yield

	Barley Grain	Sprouted Barley	% Change	Pasture
Yield				
DM, %	95	18	- 81	
Fresh wt, kg	0.13	0.55	+ 327	
DM yield, kg	0.12	0.10	- 17	
Total NE_L for 1 tray, Mcal	0.24	0.19	- 21	

Sprouting:

* 81% decrease in DM %

Hafla et al., 2014

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Sprouting:

* 81% decrease in DM %
* 327 % increase in fresh weight yield
* 17% decrease in DM yield

Hafla et al., 2014

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Sprouting:

* 81% decrease in DM %
* 327 % increase in fresh weight yield
* 17% decrease in DM yield
* 21 % loss of total energy per tray

Hafla et al., 2014

Why is DM/Energy Lost?

- Seeds utilize stored energy (starch) during the first week of growth to germinate
  - Photosynthesis doesn't really kick in until 2nd week of growth
  - Harvesting fodder before photosynthesis really takes effect
  - Net loss of energy that seed uses to germinate and get established
  - Never let fodder get to the stage of growth where nutrients start to accumulate

Putnam et al., 2013 http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=11721

Summary

- NOT a 'cheap' or 'easy' alternative to producing high-quality forages on your farm!
  - Mold/down time
  - No silver bullet
- Can be a long learning curve
- High maintenance/labor systems
- Sprouting may have application in organic, intensive, and small-scale farms with high value outputs, high land prices, and/or high alternative feed prices.
- Alternative forage source that must be thoroughly evaluated on a farm-by-farm basis

Why do I like small grains for the Northeast?

"Opportunity to reward good management"

Flexibility in harvest, storage and feeding options

Competitiveness of the crop

Utilization of "winter" growing season

Small Grain Silages

- Multiple opportunities for harvest
- Decisions can be made depending on climate, forage needs, and feed prices
- Rotation strategies
- Grazing potential

Why the interest?

- Producers looking for a forage energy or protein source that requires little or minimal weed control
- Spread crop risk
- Easy crop to establish and grow
- Double crop with corn or BMR SS
- Winter cover crop with good feed value

--scavenge excess nitrogen in fall

--harvest phos. (double P removal)

- Rotation crop with corn that leads to perennial forage seeding (underseeded)

Traditional Spring Planted Grains

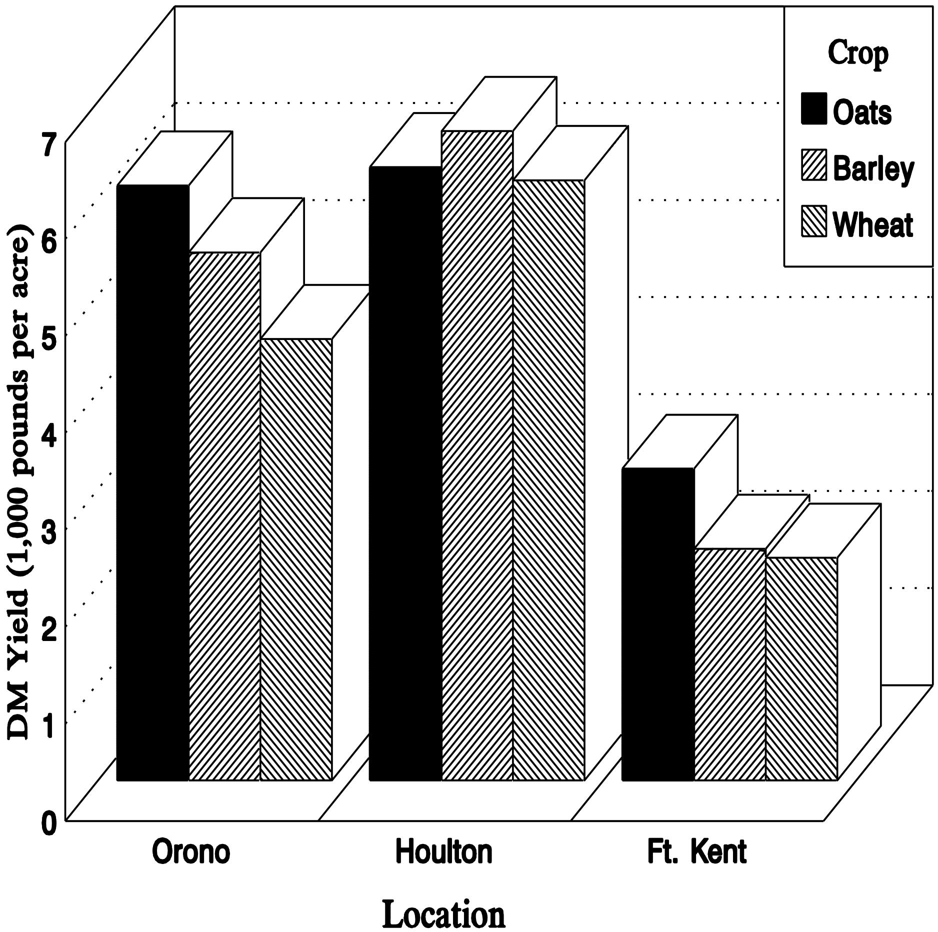
- Barley, Oats, Wheat are the traditional crops (seeding rates higher for forage vs grain) (thin stems)
- IVDMD Barley> Oats>Wheat
- When to harvest?

--Optimum forage quality?

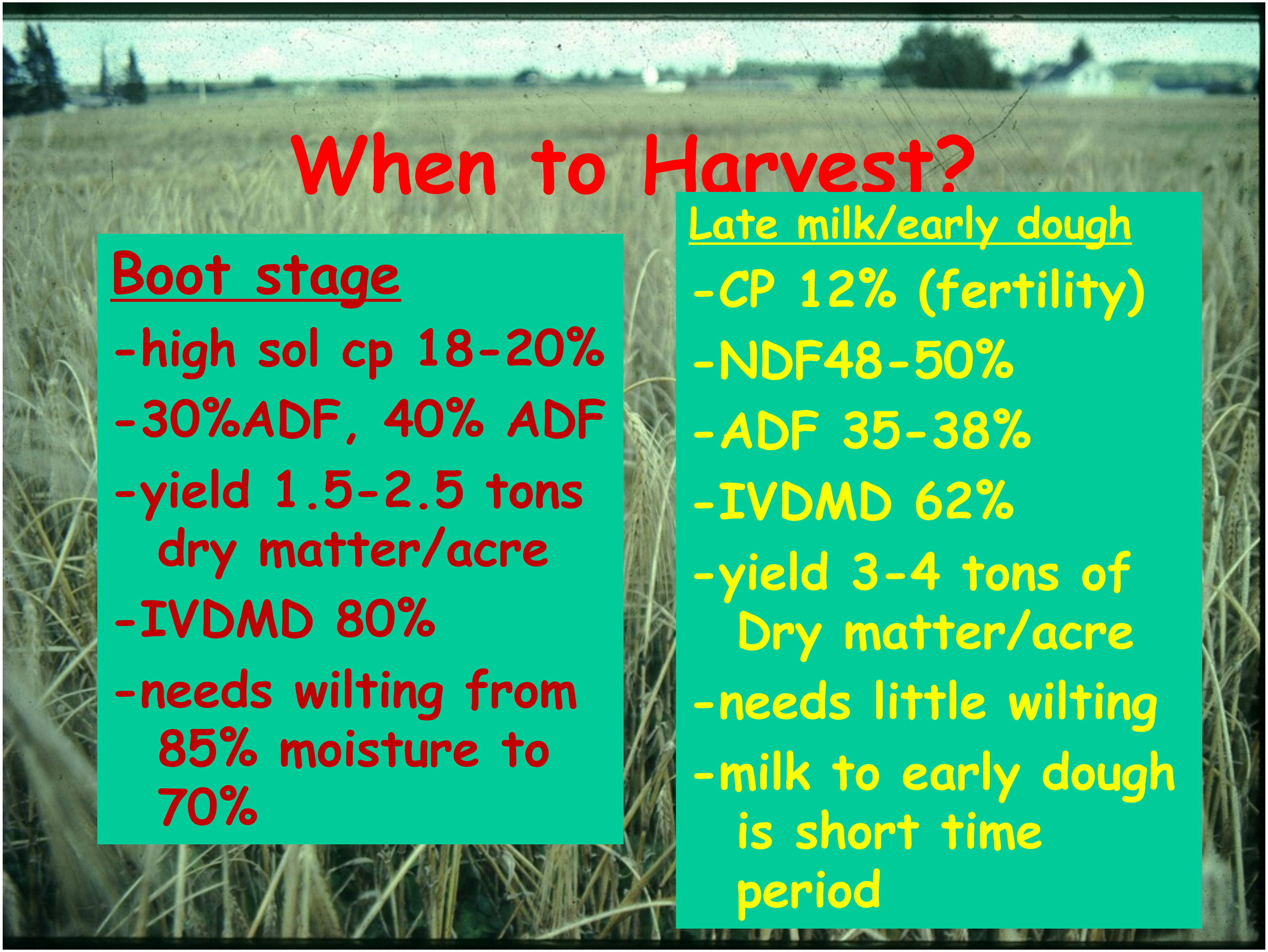
--Optimum digestible nutrients per acre? (TDN per acre)

What kind of yields?

Figure 1. Dry matter yields of small grains grown for silage in 1993 at Orono, Houlton, and Ft. Kent.



- 18 tons corn silage @30% dm 5.4 tons
- Highly responsive to nitrogen management
- Responsive to early planting
- Boot stage 1.5-2.5 tons dry matter
- Late milk-early dough stage 3-4 tons per acre



When to Harvest?

Boot stage

- -high sol cp 18-20%
- -30%ADF, 40% ADF
- -yield 1.5-2.5 tons dry matter/acre
- -IVDMD 80%
- -needs wilting from 85% moisture to 70%

Late milk/early dough

- -CP 12% (fertility)
- -NDF48-50%
- -ADF 35-38%
- -IVDMD 62%
- -yield 3-4 tons of Dry matter/acre
- -needs little wilting
- -milk to early dough is short time period

Balancing Yield *and* Quality?

Very low yield
High quality

Moderate yield
Moderate quality

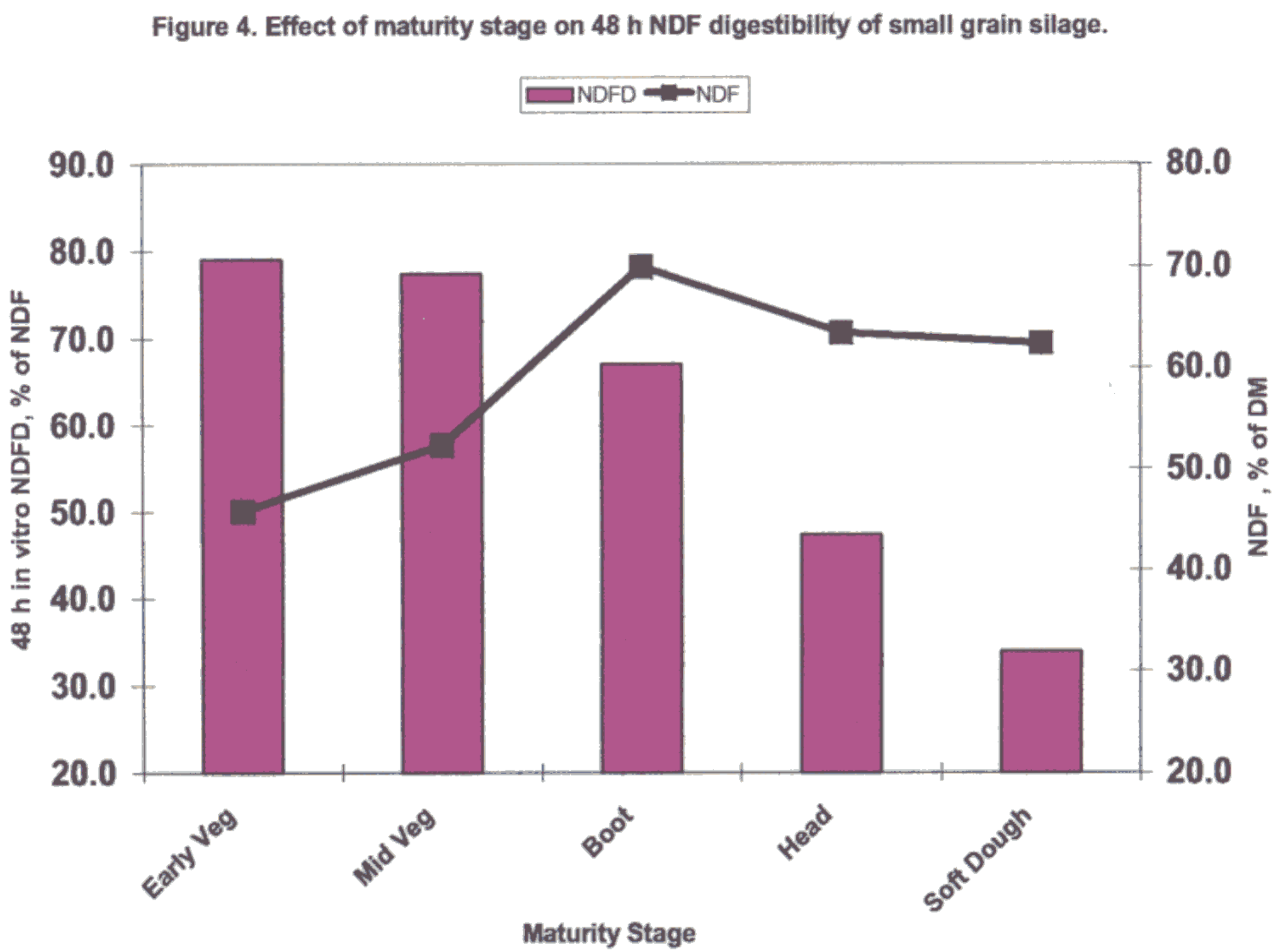


Figure 4. Effect of maturity stage on 48 h NDF digestibility of small grain silage.
NDFD
NDF
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
48 h in vitro NDFD, % of NDF
80.0
70.0
60.0
50.0
40.0
30.0
20.0
NDF , % of DM
Early Veg
Mid Veg
Boot
Head
Soft Dough
Maturity Stage

Double Crop Triticale or Rye

- Fall cover crop (September plant?)

-erosion control

-scavenge nitrogen

- Good winter survival
- Potential fall and/or early spring grazing

--*Chop early and plant short season corn*

--*Chop late and plant sorghum sudan grass*

- Other Winter Grains

--*Spelt, Winter Wheat, Winter Barley?*

Other Small grain silages

- Lots of opportunities to be creative
- Winter grains (triticale, barley, spelt, rye)
- Late summer grains (Oats sown in mid-late July can yield silages 18-20% CP in the fall)

Rotation effects

- Improve yields
- Disrupt weed and pest cycles

-significant weed seed reduction with diverse rotations/and/or sod

- Soil Quality?
- Improved varieties
- Minimun/no-till drills

-changing tillage systems will disrupt weed cycles.

Storage of homegrown grains

Grain Storages

- Is the grain to be stored dry?
- Is the storage going to be used to dry the grain?
- How long is the storage period? Maintain a moisture level.
- How big is the volume of the grain.