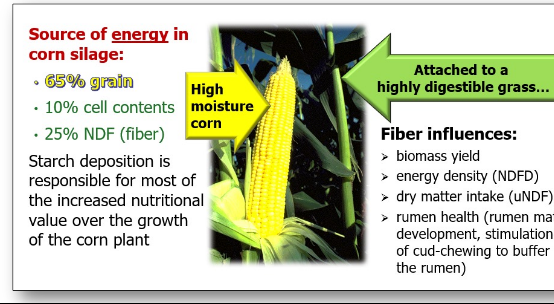
1

Introduction

Corn silage is unique crop (feed) due to the interplay between:

- growing environment,
- crop management/fertility,
- desire for high yields,
- importance of harvest timing,
- fermentation/feed-out management,
- the nutritional value and need for starch versus fiber (biomass)



2

USA Forage Production Trends

Alfalfa Declining,

(transgenic, low-lignin HarvXtra may slow this decline)

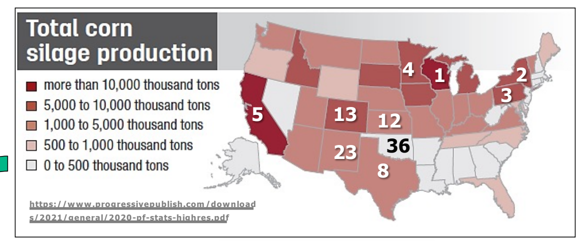
- Other sources of protein available
- Varying fiber digestibility
- Requires multiple harvests
- Does not utilize manure

Corn Silage Production Increasing

(but with fewer cows, this means higher dietary inclusion rates)

- Stable, high yields
- High energy (starch)
- High fiber digestibility
- Only 1 harvest/year
- Utilizes manure

3

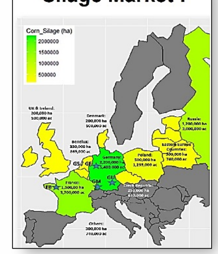


8% of all corn acres

7M acres harvested

2.8M corn units

Silage Market :



EU + Russia have >3x CS Acres in the USA

80-85 day maturities

4

Take Home Message Number 1

When selecting silage genetics, talk to your agronomist/seed salesman <u>first</u> and your nutritionist second.

5

What Makes Good Silage Genetics

- ❑ To be a good silage hybrid, it must **start out as an <u>agronomically-stable</u> hybrid with good grain yield** because you can <u>not</u> overcome lack of starch (>90% digestible) with small increases in fiber digestibility (60-70% digestible)
- ❑ **BUT…not every grain hybrid makes a good silage hybrid because they may be too short** and not deliver the desired stover (biomass) yields

6

Traits <u>To</u> Focus on When Selecting Silage Genetics

1. Basic Agronomic Traits (Yield Stability/Plant Health)

Heat units to silk and maturity, technology traits,
stress emergence, drought tolerance,
disease resistance (NLB, Tar Spot, ear molds)

2. Dry Matter Yield

Influenced by plant height at the ear (biomass yield) and starch (grain) content

3. Starch Content

- Most energy dense component of the plant
- Influenced heavily by harvest maturity of the kernel
- Shorter statured plants can be high in starch but may lack overall biomass (tonnage).

7

Take Home Message Number 2

Don't get <u>too</u> hung up on silage hybrid nutritional traits other than starch <u>content.</u>

8

Traits **Not** To Focus on When Selecting Silage Genetics
(but certainly important to nutritionists when feeding the silage)

Fiber Digestibility

- Not a selection trait - little genetic variation between non-BMR's (standard hybrids)
  - Look at University silage plots and it is rare for a hybrid to be statistically higher in NDFD than the plot average unless it is a BMR hybrid
  - Why BMR hybrids have been commercialized

9

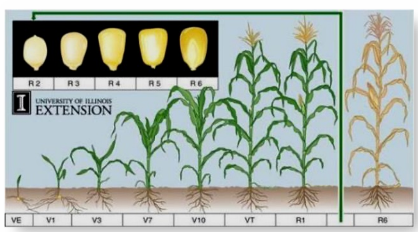
What Does the Research Say?

- Growing environment is 3X more influential on NDFD than genetics.
  (Dr. Fred Owens, Retired Pioneer Research Scient

- Moisture the plant receives is 7-times more influential on fiber digestibility than heat units.
  (Dr. Mike VanAmburgh, Cornell University)

10

- The growing environment **during the vegetative stage** affects corn plant height (and biomass yield) and NDFD
  - **Dry conditions => shorter plant, higher NDFD**
  - **Wet conditions => taller plant, lower NDFD**



- **After silking** growing environment primarily affects grain yield and thus the starch content and energy density of the resulting corn silage

11

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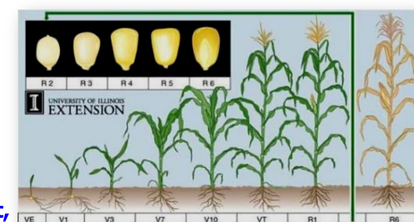

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- **The ideal growing environment for corn silage is slightly dry during the vegetative stage (but not so dry as to significantly shorten plant and reduce biomass yield) , then plenty of moisture during grain fill.**

12

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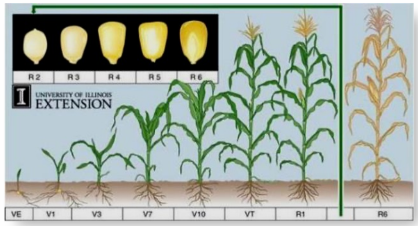

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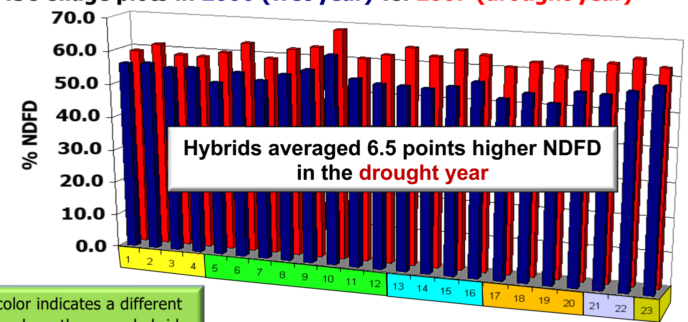
- **The ideal growing environment for corn silage is slightly dry during the vegetative stage (but not so dry as to significantly shorten plant and reduce biomass yield) , then plenty of moisture during grain fill.**

- **Fiber digestibility DOES NOT change due to the ensiling process**
- **Starch digestibility DOES change over time in fermented storage**

13

Growing Environment NOT Genetics Is the Main Influencer of Fiber Digestibility

Growing Environment Effect on the Same Hybrids Grown in MSU silage plots in 2006 (wet year) vs. 2007 (drought year)



Each block color indicates a different plot location where the same hybrid was grown in both years

Source: Dann Bolinger, Pioneer Dairy Specialist - Michigan

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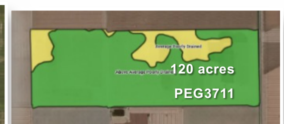
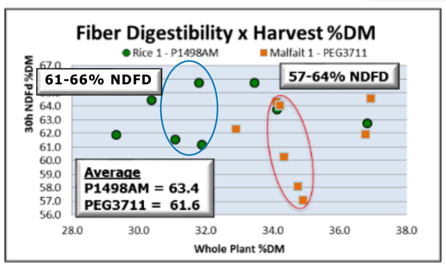
Within Field
Variation in Soil Types
(Water Holding Capacity, N-profile)
Also Influences NDFD



- Fields were extremely uniform, both internally and by comparison.
- 8 samples representing 8 random loads from a single field for each hybrid.



Within Field Variation Much Greater than Genetic Differences

Source: Dann Bolinger 2016. Pioneer Michigan/Ohio Dairy Specialist

15

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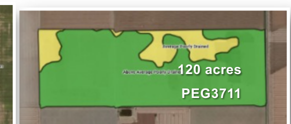

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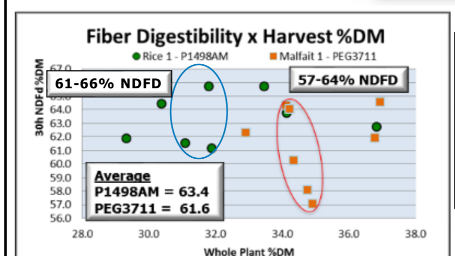

Within Field Variation Much Greater than Genetic Differences

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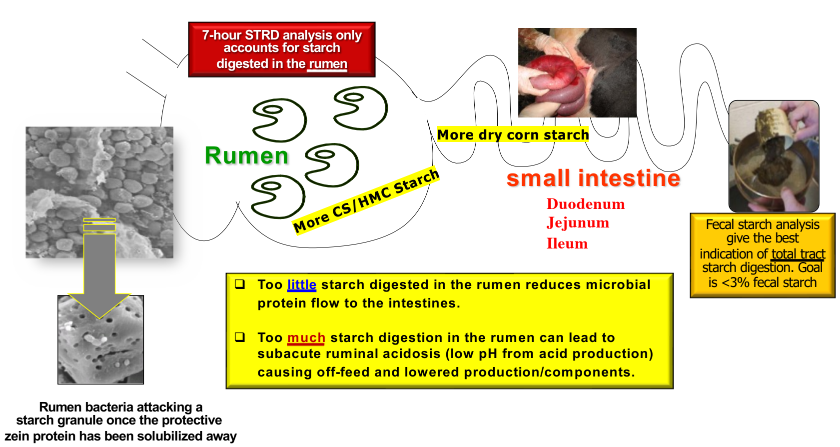
16

What About Starch Digestibility?

First a Short Primer on Starch Digestion

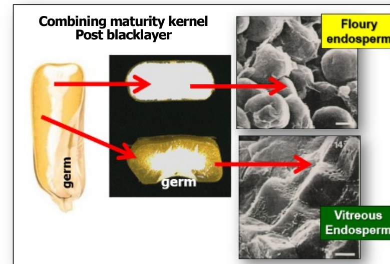


- Too little starch digested in the rumen reduces microbial protein flow to the intestines.
- Too much starch digestion in the rumen can lead to subacute ruminal acidosis (low pH from acid production) causing off-feed and lowered production/components.

18

What About Starch Digestibility?

- No significant differences among hybrids at silage maturity
  - Yes, at combining maturity because hybrids have different test weights
    - higher test weight meaning kernels contain more hard, vitreous starch
  - Very little hard, vitreous starch laid down in the kernel at silage harvest maturities (1/2-3/4 milkline)
    - Which is why University silage hybrid trials do NOT analyze hybrid entries for starch digestibility



19

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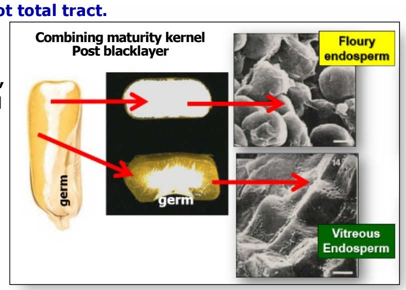
    - Which is why University silage hybrid trials do NOT analyze hybrid entries for starch digestibility
  - Remember that 7-hour starch digestibility data promoting soft-textured, floury corn only references ruminal digestion, not total tract.
    - fecal starch analysis will indicate total tract starch digestibility
  - Influenced most by growing environment, kernel maturity, degree of processing and time in fermented storage



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Starch Digestibility of Corn – Silage and Grain

Jeffrey L. Firkins
Department of Animal Science
The Ohio State University

Need to consider if referencing:

- Silage kernels (pre-blacklayer)

or

- Combined kernels (post-blacklayer)

Conclusions

Taken together with other studies described, I conclude that there should be an optimum NSC availability in the rumen that is consistent with efficient rumen microbial metabolism. Clearly, the amount of RDS depends on the maturity, DM percentage, and processing of corn silage. Some silages might be lower in RDS than others, so we still need to develop or improve methodology to predict starch availability in silages in a systematic laboratory analysis that will help nutrition advisors to better account for varying RDS. Until more work is done, the Wisconsin index (Ferreira and Mertens, 2005) for particle size should be considered to predict total tract starch digestibility. Vitreousness of corn grain in silage seems to be of relatively little value. In contrast, vitreousness or perhaps gelatinization of dry corn grain should be considered, particularly to help users know when to grind corn more finely. Using these considerations for coarse adjustment of rations, the amount of RDS can be fine-tuned with more slowly available byproducts or increased moderately with small amounts of sugars according to individual herd or group needs. As ration balancing and feeding systems continue to improve in reliability and repeatability, nutrition advisors will still have to use their knowledge of nutrition to continue to keep pace with other feeding management practices.

Presented at the Tri-State Nutrition Conference April 25, 2006

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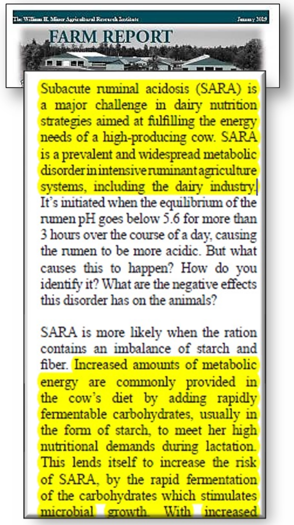
Do We Really Want Higher Ruminal Starch Digestion?

- SARA (rumen upsets due to low pH) is a major challenge in herd pushing for high production
- We will continue w/ high corn-based diets



The William H. Miner Agricultural Research Institute January 2019

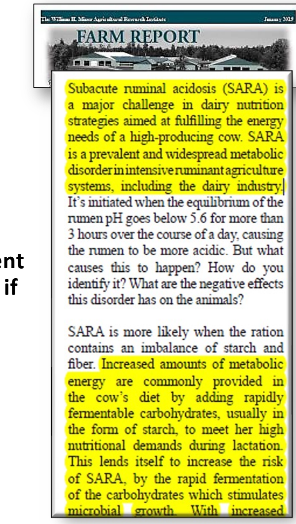
FARM REPORT

Subacute ruminal acidosis (SARA) is a major challenge in dairy nutrition strategies aimed at fulfilling the energy needs of a high-producing cow. SARA is a prevalent and widespread metabolic disorder in intensive ruminant agriculture systems, including the dairy industry. It's initiated when the equilibrium of the rumen pH goes below 5.6 for more than 3 hours over the course of a day, causing the rumen to be more acidic. But what causes this to happen? How do you identify it? What are the negative effects this disorder has on the animals?

SARA is more likely when the ration contains an imbalance of starch and fiber. Increased amounts of metabolic energy are commonly provided in the cow's diet by adding rapidly fermentable carbohydrates, usually in the form of starch, to meet her high nutritional demands during lactation. This lends itself to increase the risk of SARA, by the rapid fermentation of the carbohydrates which stimulates microbial growth. With increased

Do We Really Want Higher Ruminal Starch Digestion?

- SARA (rumen upsets due to low pH) is a major challenge in herd pushing for high production
- We will continue w/ high corn-based diets
- Fecal starch levels on most well-managed herds are already below 3% so improvement in total tract starch digestibility, especially if accompanied by any reduction in yield, seems of little value.



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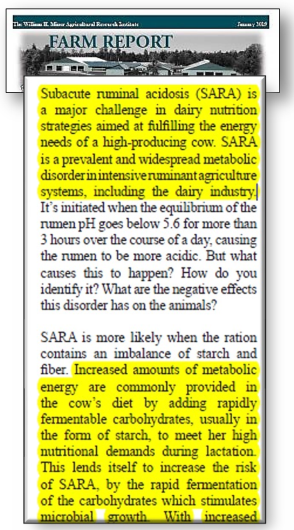
- We will continue w/ high corn-based diets
- Fecal starch levels on most well-managed herds are already below 3% so improvement in total tract starch digestibility, especially if accompanied by any reduction in yield, seems of little value.
- Nutritionists appear more concerned with reducing, rather than increasing, ruminal starch digestibility in high corn grain/silage based diets exemplified by the move away from high-moisture corn to dry corn in many dairy diets.



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Take Home Message Number 3

Pay close attention to the "farming" side of corn silage production.

Tillage practices and planting accuracy is just as important for silage as for grain production.

Proper Tillage

Some of the varied root development due to:

- ❑ **compaction layers**
- ❑ **planter** performance (seed to soil contact)
- ❑ **planting too shallow** resulting in nodal roots not developing properly

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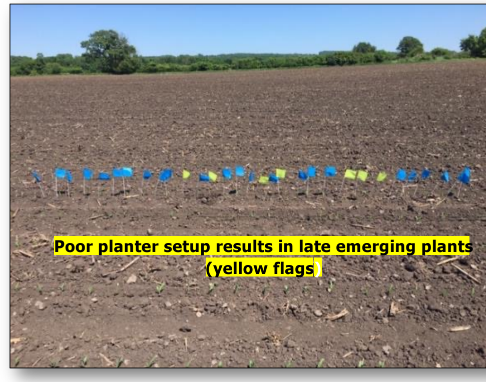
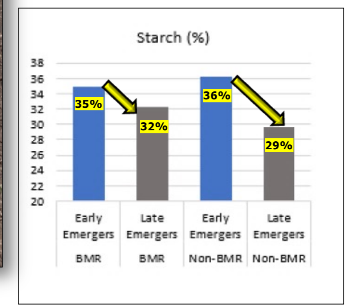
Proper Planter Setup



- ❑ A 2016 Wisconsin field study on late emerging plants showed that 19% of plants were 12-72 hours late emerging resulting in 7% lower starch content in a standard hybrid and 3 points lower in a BMR hybrid.



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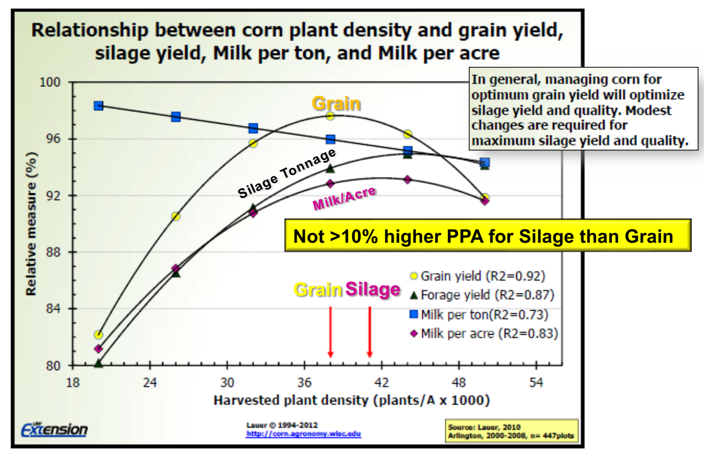
Take Home Message Number 4

Plant at proper populations to optimize both starch and biomass yield.

30



Source: Dr. Joe Lauer, UW State Corn Extension Specialist,
Pioneer Corn Silage presentation January 31, 2012, Johnston, IA

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Lower Plant Populations Do NOT Increase NDFD

Figure 4. Effect of planting density on DM yield and plant structure (Ferreira and Teets, 2017).

Item	Planting density[1]					P <[2]		
	55K	70K	85K	100K	SEM	Trt	L	Q
DM, %	32.1	31.7	31.5	31.4	0.28	0.29	0.07	0.59
Plant dry weight, g/plant	376	334	284	253	7.4	0.01	0.01	0.46
DM yield, Mg/ha	19.8	21.5	23.4	26.0	0.5	0.01	0.01	0.41
Kernel lines per ear, count	17.1	16.5	16.0	16.3	0.26	0.03	0.02	0.09
Kernels per line, count	42.2	38.9	35.6	33.9	0.69	0.01	0.01	0.25
Kernels per ear, count	720	641	570	553	13	0.01	0.01	0.03
Stem width, mm	19.7	18.9	17.4	17.0	0.32	0.01	0.01	0.64

[1]55K = 55,000 plants/ha; 70K = 70,000 plants/ha; 85K = 85,000 plants/ha; 100K = 100,000 plants/ha.
[2]Trt = treatment; L = linear response; Q = quadratic response.

Figure 5. Effect of planting density on nutritional composition (DM basis) of fresh corn (Ferreira and Teets, 2017).

Item	Planting density[1]					P <[2]		
	55K	70K	85K	100K	SEM	Trt	L	Q
Ash, %	3.5	3.7	3.7	3.7	0.07	0.17	0.11	0.14
CP, %	10.2	10.2	10.3	10.3	0.12	0.90	0.61	0.85
NDF, %	36.5	38.0	38.2	38.2	0.54	0.09	0.04	0.17
ADF, %	21.6	22.3	23.0	22.7	0.39	0.11	0.04	0.24
ADL, %	2.4	2.5	2.4	2.2	0.13	0.35	0.16	0.27
Starch, %	33.4	34.4	33.5	33.5	0.48	0.46	0.72	0.27
Sugars, %	12.3	12.4	12.7	11.5	0.34	0.15	0.15	0.07
30-h IVNDFD,[3] % of NDF	45.9	43.9	42.4	43.8	1.08	0.12	0.12	0.14

[1]55K = 55,000 plants/ha; 70K = 70,000 plants/ha; 85K = 85,000 plants/ha; 100K = 100,000 plants/ha.
[2]Trt = treatment; L = linear response; Q = quadratic response.
[3]IVNDFD = ruminal in vitro NDF digestibility.

- A more recent 2017 study by Ferreira and Teets (2017) examined two different standard hybrids planted in seven different fields at **23,000, 29,000, 35,400, 41,600 ppa.** (55,000, 70,000, 85,000 and 100,000 plants per hectare).
- This study demonstrated that planting density increased yield and while reducing stalk diameter (Figure 4), did not significantly (P>0.12) reduce 30-hour ruminal in vitro NDFD of the resulting silage (Figure 5).

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Take Home Message Number 5

Don't harvest healthy plants too early.

Look at both kernel maturity and whole plant moisture as harvest triggers.

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In the Past, Perhaps Too Much Emphasis on Whole-Plant Moistures to Trigger Silage Harvest

Silage "burn-down" days

Whole-plant moistures then determined with a Koster Moister Tester or Microwave

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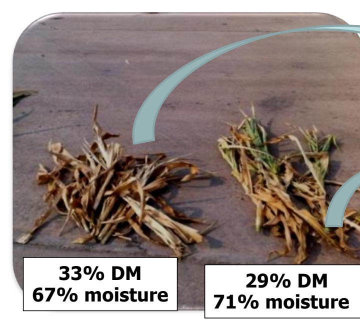
Example of Low DM Content Due to Lack of Ear/kernel Development (starch deposition)



Whole plant samples from Colorado on 8/14/12 after experiencing both drought and hail damage

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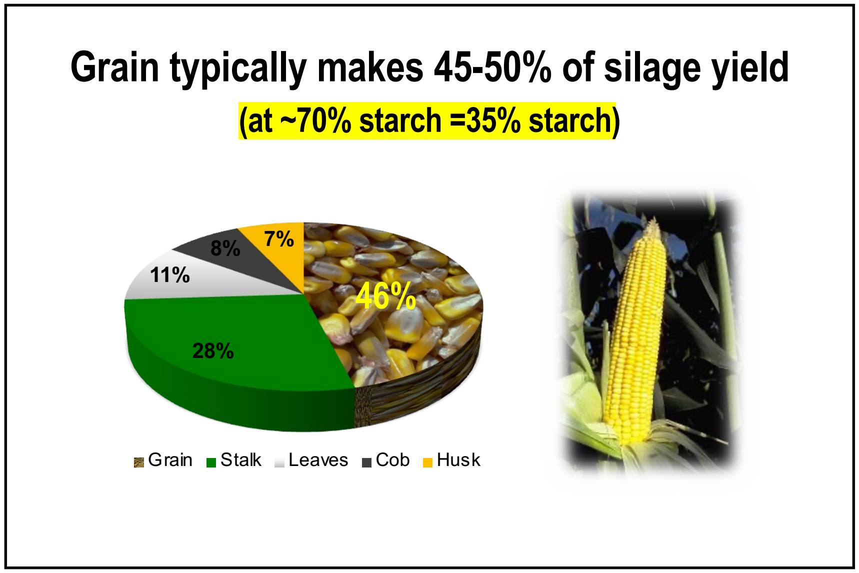

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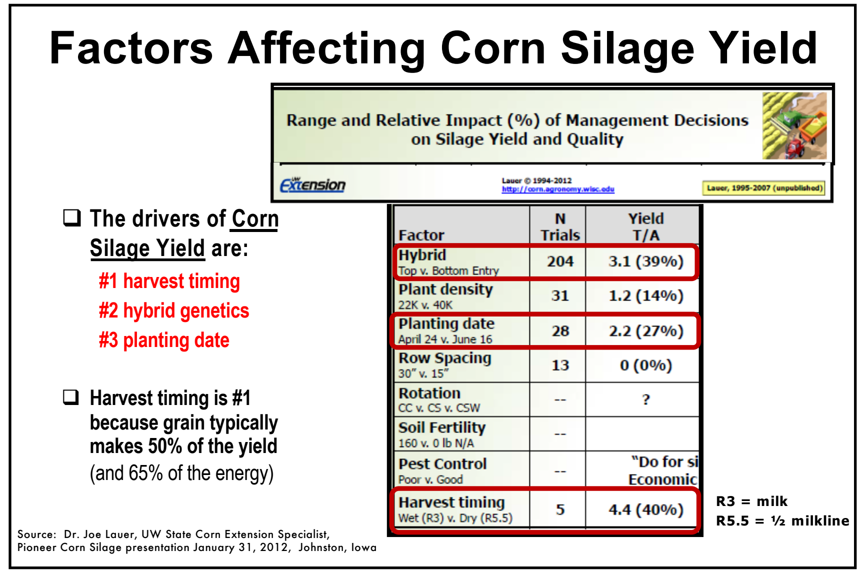

Factor	N Trials	Yield T/A
Hybrid Top v. Bottom Entry	204	3.1 (39%)
Plant density 22K v. 40K	31	1.2 (14%)
Planting date April 24 v. June 16	28	2.2 (27%)
Row Spacing 30" v. 15"	13	0 (0%)
Rotation CC v. CS v. CSW	--	?
Soil Fertility 160 v. 0 lb N/A	--	
Pest Control Poor v. Good	--	"Do for si Economic
Harvest timing Wet (R3) v. Dry (R5.5)	5	4.4 (40%)

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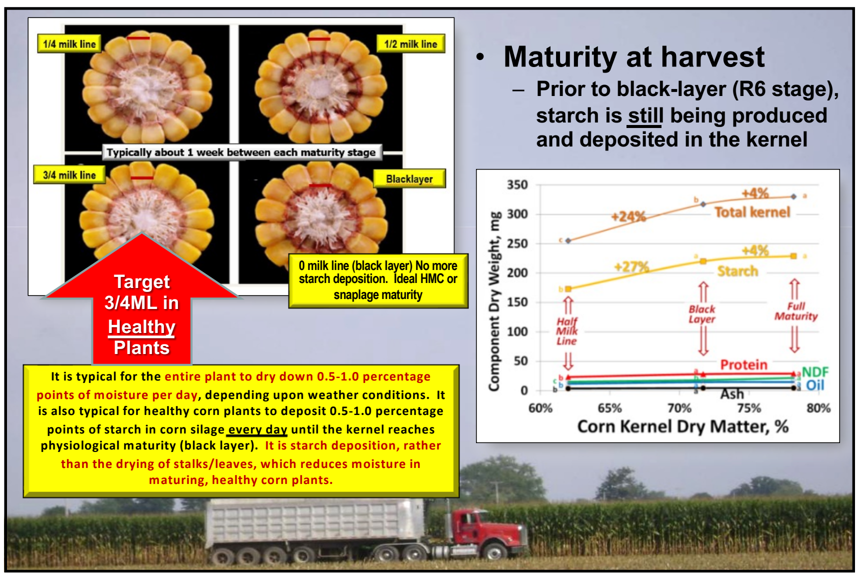

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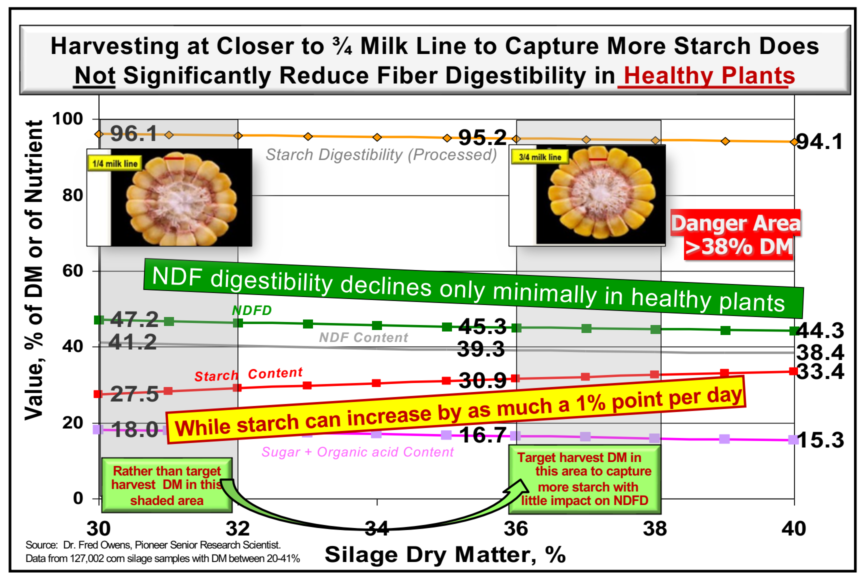

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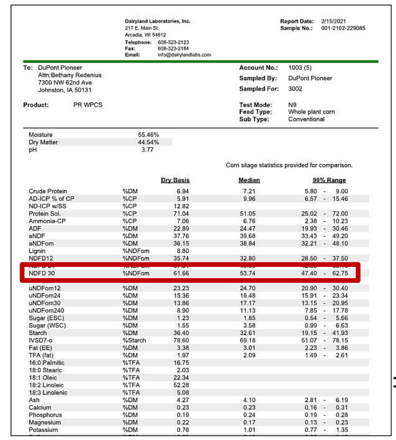
Take Home Message Number 6

Consider management options to improve fiber digestibility.

Target the highest NDFD corn silage to transition and high-string cows.

Monetizing Modest NDFD Changes in a Dairy Diet



Dairyland Laboratories, Inc.
217 E. Main St.
Arcadia, WI 54612
Telephone: 608-323-2123
Fax: 608-323-2184
Email: info@dairylandlabs.com

Report Date: 2/15/2021
Sample No.: 001-2102-229085

To: DuPont Pioneer
Attn:Bethany Redenius
7300 NW 62nd Ave
Johnston, IA 50131

Account No.: 1003 (5)
Sampled By: DuPont Pioneer
Sampled For: 3002

Product: PR WPCS

Test Mode: N9
Feed Type: Whole plant corn
Sub Type: Conventional

Moisture	55.46%
Dry Matter	44.54%
pH	3.77

Corn silage statistics provided for comparison.

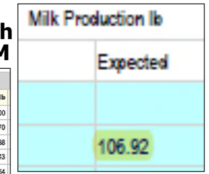
		Dry Basis	Median	90% Range
Crude Protein	%DM	6.94	7.21	5.80 - 9.00
AD-ICP % of CP	%CP	5.91	9.96	6.57 - 15.46
ND-ICP w/SS	%CP	12.82		
Protein Sol.	%CP	71.04	51.05	25.02 - 72.00
Ammonia-CP	%CP	7.06	6.76	2.38 - 10.23
ADF	%DM	22.89	24.47	19.93 - 30.46
aNDF	%DM	37.76	39.68	33.43 - 49.20
aNDFom	%DM	36.15	38.84	32.21 - 48.10
Lignin	%NDFom	8.80		
NDFD12	%NDFom	35.74	32.80	28.50 - 37.50
NDFD 30	%NDFom	61.66	53.74	47.40 - 62.75
uNDFom12	%DM	23.23	24.70	20.90 - 30.40
uNDFom24	%DM	15.36	19.48	15.91 - 23.34
uNDFom30	%DM	13.86	17.17	13.15 - 20.95
uNDFom240	%DM	8.90	11.13	7.85 - 17.78
Sugar (ESC)	%DM	1.23	1.85	0.54 - 5.66
Sugar (WSC)	%DM	1.55	3.58	0.99 - 6.63
Starch	%DM	36.40	32.61	19.15 - 41.93
IVSD7-o	%Starch	78.60	69.18	51.07 - 78.15
Fat (EE)	%DM	3.38	3.01	2.23 - 3.86
TFA (fat)	%DM	1.97	2.09	1.49 - 2.61
16:0 Palmitic	%TFA	16.75		
18:0 Stearic	%TFA	2.03		
18:1 Oleic	%TFA	22.34		
18:2 Linoleic	%TFA	52.28		
18:3 Linolenic	%TFA	5.08		
Ash	%DM	4.27	4.10	2.81 - 6.19
Calcium	%DM	0.23	0.23	0.16 - 0.31
Phosphorus	%DM	0.19	0.24	0.19 - 0.28
Magnesium	%DM	0.22	0.17	0.13 - 0.23
Potassium	%DM	0.76	1.01	0.77 - 1.35

Typical dairy diet with 20 lbs corn silage DM

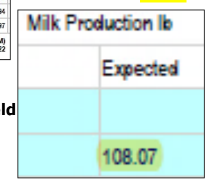
Recipe: 100 lbs milk			
Ingredients	D.M. %	A.F. lb	DM lb
Corn Silage CFT 38 STR 4.2 B3	33.0000	60.0000	19.8000
Alfalfa silage 47.3322	46.8200	35.0000	16.3870
Soybean Meal 47.5 Solvent	90.0000	7.8264	7.0438
Corn Grain Ground Fine	88.0000	9.0390	7.9543
Corn Dist Ethanol	88.8000	4.4092	3.9154
Megalac	97.0000	0.5512	0.5346
Magnesium Ox	99.5000	0.2205	0.2194
Vitamin Premix ADE	99.5000	0.2205	0.2194
Trace Mineral Premix	99.5000	0.2205	0.2194
Salt White	99.5000	0.2205	0.2194
Mineral Premix 1:1	99.5000	0.1102	0.1097
Totals		117.8178	(48.1 %DM) 56.6222

1 more lb marginal milk yield = 12-18 cent/cow/day

Expected milk with NDFD30 = 47%



Expected milk with NDFD30 = 51%



High-Chopping Review of 11 Studies

Increasing chop height from 7" to 20"

Table 1. Average nutrient content and production of corn silage harvested at low or high levels of height (summarized from 11 studies)[1].

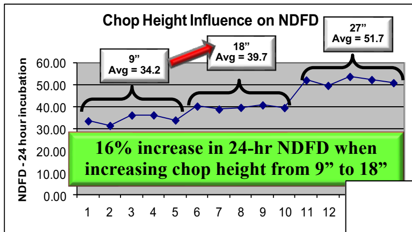
Item	Low height (6.8 ± 2.5")	High height (19.3 ± 2.8")	Change (%)
DM, %	38.1	40.3	6.0
CP, %	7.0	7.1	2.0
ADF, %	24.2	21.8	-10.2
NDF, %	41.6	38.6	-7.4
Starch, %	30.6	32.4	5.9
NEL, Mcal/lb	0.71	0.74	4.2
NDF digestibility, %[2]	50.6	54.0	6.7
DM digestibility, %[2]	78.6	80.6	2.5
Yield, ton/ac, DM	8.1	7.5	-7.4

Source: http://www.das.psu.edu/user/publications/pdf/das03-72.pdf

You Do Give Up Some Yield When High-Chopping

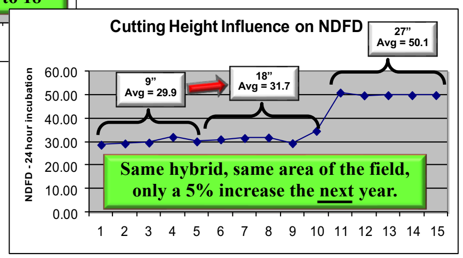
- **The 11 trial summary showed that whole plant yield decreased about ½ ton (30% DM) silage for every 4" increase in chop height**
- **Keep in mind that the yield loss is relatively undigestible fiber from lower internodes, not leaves, ear or more digestible upper stalk internodes**

Field Trial Example of Growing Environment Impacts High Chopping Decisions



Trial Background: Fiber digestibility data from 5 plants harvested at 3 different chop heights from the same hybrid (34B23) sampled from same section of same field in 2000 and again in 2001

The only way to know if high-chopping will significantly increase fiber digestibility is to sample whole plants just prior (~2 weeks) to harvest and rapidly analyze with a NIR for fiber digestibility (NDFD)



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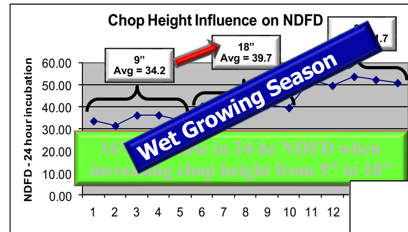
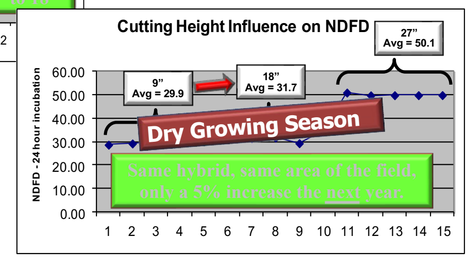
Field Trial Example of Growing Environment Impacts High Chopping Decisions



Trial Background: Fiber digestibility data from 5 plants harvested at 3 different chop heights from the same hybrid (34B23) sampled from same section of same field in 2000 and again in 2001

The only way to know if high-chopping will significantly increase fiber digestibility is to sample whole plants just prior (~2 weeks) to harvest and rapidly analyze with a NIR for fiber digestibility (NDFD)



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Brown Mid Rib Corn Hybrids

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Higher NDFD with BMR Hybrids

Higher NDFD impacts:

- The amount of forage in the diet (typically more forage = a cheaper ration)
- The energy obtained from the silage
- The amount of forage cows can eat per day because **BMR fiber is more fragile and exits the rumen faster than fiber from non-BMR hybrids**

The main nutritional advantage of BMR silage is higher intakes from higher fiber digestibility and higher cell wall fragility due to less lignin

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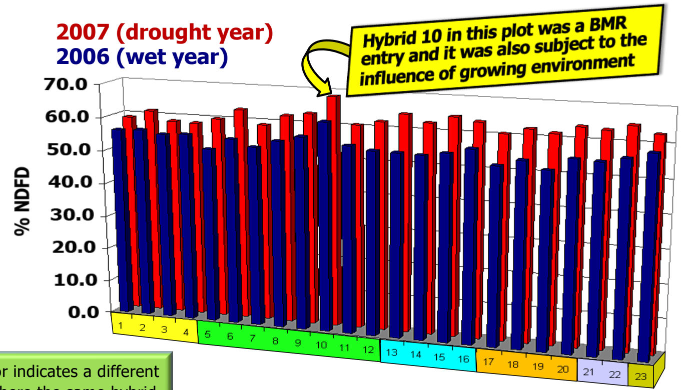
Growing Environment Impacts the Fiber Digestibility of BMR in a Similar Manner To Non-BMR Hybrids



Each block color indicates a different plot location where the same hybrid was grown in both years

Source: Dann Bolinger, Pioneer Dairy Specialist - Michigan

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Set Realistic BMR Expectations

vs. standard corn silage hybrids

- Potential for more agronomic risk (standability, need for fungicides etc.)
- Slightly reduced yields (10-20% depending upon growing conditions)
- Extra inventory needed due to slightly reduced yields and higher feed intake of BMR silage
- **Show most value in transition and high-string diets.**

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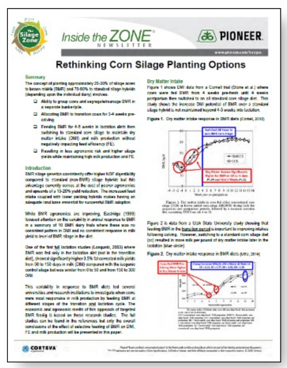
Re-thinking (current) BMR hybrid utilization in terms of milk yield and agronomic risk.

- **The concept of planting approximately 20-30% of silage acres to brown midrib (BMR) and 70-80% to standard silage hybrids (depending upon the individual dairy) involves:**
  - Ability to group cows and segregate/manage BMR in a separate bunker/pile.
  - Allocating BMR to transition cows for 3-4 weeks pre-calving.
  - Feeding BMR for 4-5 weeks in lactation diets then switching to standard corn silage to maintain dry matter intake (DMI) and milk production without negatively impacting feed efficiency (FE).
  - Resulting in less agronomic risk and higher silage yields while maintaining high milk production and FE.



Send Bill Mahanna an email (bill.Mahanna@pioneer.com) and will gladly send you this document highlighting university research studies supporting this concept of BMR feeding.

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Take Home Message Number 7

Closely monitor chop length and kernel processing at time of harvest.

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Corn Silage Chop Length

- There is no "ideal" chop length for corn silage. It depends on the inclusion level of all the other forages in the ration.
- Corn silage is typically chopped at 19mm (3/4") and haylage about 15-19mm to ensure adequate "effective" fiber levels.
- Research by Miner Institute indicates particle size seems to influence eating time more than rumination time and suggest CS be chopped from 16-22mm and no longer.
  - Cows has similar ECM whether the diet was higher in undigested fiber (uNDF240) but chopped fine OR if the diet was lower in uNDF but with coarser particle size (peNDF).
  - Very long particles in the diet will prolong eating time <u>without</u> providing any greater rumination stimulation because cows tend to chew to a relatively uniform particle size (8mm screen on PSPS) before swallowing.
  - Cows fed low effective fiber (peNDF) diets that were also low in undigested fiber (uNDF240) ate 5 lb more DM/day and spent 45 minutes less time at the feed bunk (not exceeding 5 hours/day eating to allow for more resting time).

Table 2. Key diagnostics from the cows

Item	Low uNDF240 Low peNDF (1)	Low uNDF240 High peNDF (2)	High uNDF240 Low peNDF (3)	High uNDF240 High peNDF (4)
DMI, lbs./day	60.6^{a}	60.2^{a}	60.4^{a}	54.9^{b}
ECM, lbs./day	103.6^{a}	100.8^{ab}	102.3^{ab}	98.3^{b}
Eating time, min./day	255.4^{b}	262.5^{b}	279.1^{ab}	300.3^{a}
Rumination, min./day	523.2	526.5	531.8	544.5

^{ab}Means in a row where unlike superscripts differ ($P < 0.05$).

https://hayandforage.com/article-2769-rethinking-forage-particle-size.html

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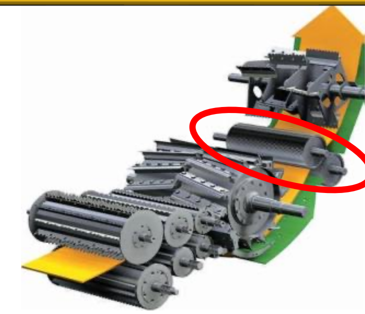
Monitoring Kernel Processing

If <u>chopping longer</u> (19-22mm) and/or <u>harvesting more mature</u> (to capture more starch), it is important to have the kernels adequately processed



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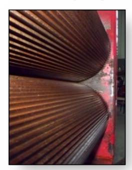
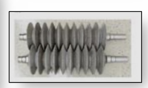
Kernel Processing Guidelines

1. **Check roller mill wear**
   1. Typical life is ~400 hours unless chromed roller mills ~1000 hours
   2. Check aggressiveness of teeth design (# teeth/inch)
2. **Roller mill gap set at 1-3mm for adequate kernel pericarp damage**
3. **Do not set chop length <u>over</u> 19mm (3/4") unless using a processor like Shredlage designed for chopping**
   1. set shorter (17mm) if you do not have a great need for peNDF (scratch) coming from the corn silage as because <u>all</u> choppers will do a better job of processing at shorter chop lengths
   2. some processors (Shredlage) with roller differentials over 50% can chop as long as 30mm and still achieve excellent kernel damage
   3. any chopper can do a good job if chop length, differential and roller mill setting (and wear) are managed correctly.
4. **Check the roller mill differential**
   1. Historically processors were set at between a 10-20% differential.
   2. **The higher the differential (e.g. 40-50%) improves the ability of all processors to adequately damage kernels.**

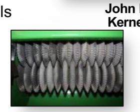


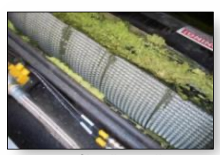
Conventional rolls

John Deere KernelStar



Krone Disc Processor





Shredlage rolls (patent purchased by Claas)

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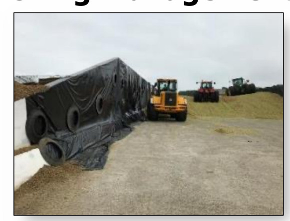
Absolutely <u>perfect</u> ensiling management



But the cows will suffer production because the roller mill was 3 years old (4500 engine hours) and it had <u>never</u> been changed

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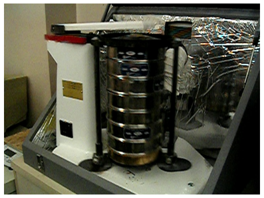
Kernel Processing Scoring

This is the Ro-Tap lab method to quantify kernel damage
Jointly developed by Pioneer, Dave Mertens and Dairyland Labs (Arcadia, WI)



- Quantifies percent of starch in damaged vs. undamaged kernels. Available commercially from Dairyland Labs (Arcadia, WI) and Cumberland Valley Lab (Hagerstown, MD) for ~ $18.00

This is the most important sieve, the 4.75mm screen (0.187 in)

Starch not as available in kernels on or above the 4.75mm screen (traps ¼ kernel pieces and greater)

4.75mm screen

Starch passing this screen is more available and what is reported as "damaged" or "% passing coarse screen" on lab results

Sieve (mm)	Fiber and starch separations
19	coarse
13	coarse
9.5	coarse
6.7	coarse
4.75	coarse / starch sieve
3.35	medium
2.36	medium
1.18	Medium/peNDF sieve
0.6	fine
pan	fine

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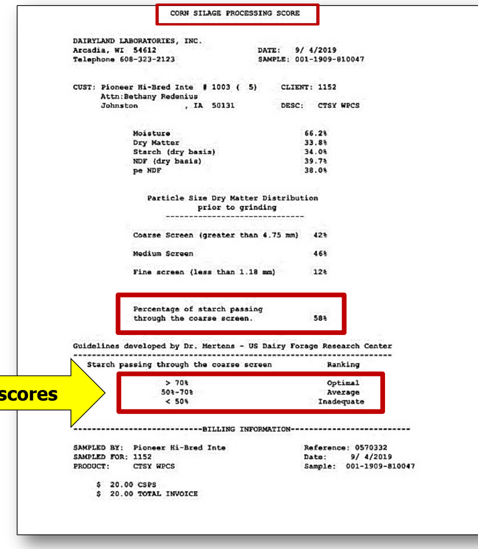
Example of a laboratory kernel processing report showing an "average" processing score.

Recommended processing scores



CORN SILAGE PROCESSING SCORE

DAIRYLAND LABORATORIES, INC.
Arcadia, WI 54612 DATE: 9/ 4/2019
Telephone 608-323-2123 SAMPLE: 001-1909-810047

CUST: Pioneer Hi-Bred Inte # 1003 (5) CLIENT: 1152
Attn:Bethany Redenius
Johnston , IA 50131 DESC: CTSY WPCS

Moisture	66.2%
Dry Matter	33.8%
Starch (dry basis)	34.0%
NDF (dry basis)	39.7%
pe NDF	38.0%

Particle Size Dry Matter Distribution prior to grinding

Coarse Screen (greater than 4.75 mm)	42%
Medium Screen	46%
Fine screen (less than 1.18 mm)	12%

Percentage of starch passing through the coarse screen. 58%

Guidelines developed by Dr. Mertens - US Dairy Forage Research Center

Starch passing through the coarse screen	Ranking
> 70%	Optimal
50%-70%	Average
< 50%	Inadequate

BILLING INFORMATION

SAMPLED BY: Pioneer Hi-Bred Inte Reference: 0570332
SAMPLED FOR: 1152 Date: 9/ 4/2019
PRODUCT: CTSY WPCS Sample: 001-1909-810047

$ 20.00 CSPS
$ 20.00 TOTAL INVOICE

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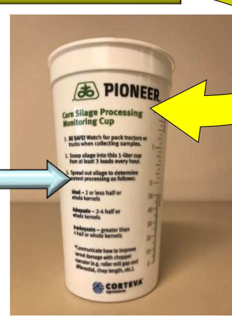
Pioneer Processing Cup to Assess Degree of Kernel Processing During Harvest

Best field test is a 1 liter cup….if you see more than 2-4 half or whole kernels in this volume of silage, then chopper adjustments may be called for:

Ideal = 2 whole kernels or less
Adequate = 2 to 4 kernels
Inadequate = more than 4 kernels



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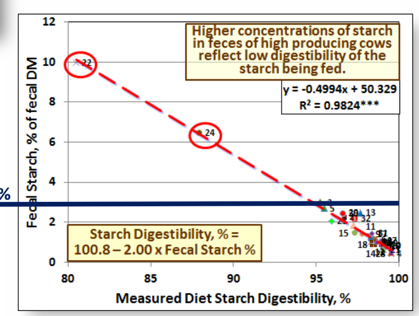
2015 Wisconsin Field Study

Herds: 32 dairies in the Upper Midwest.
Cows: Top strings from each herd (106#)
Diets: Kernel processed corn silage fermented 8 months; corn grain (Dry rolled, HMC, or earlage)
TMRs averaged 26% starch 31% NDF.
Samples: Corn silage, grain, TMR, feces.

Bill Powel-Smith

The two herds with high fecal starch had poor silage kernel processing

Goal is <3% starch in feces. All these high-producing herds met that hurdle except two and they have very poor corn silage kernel processing scores (lots of large kernel pieces). They also obtained high production, but it likely required addition of more expensive starch into the diet.



This data was presented as a research poster (T437) at the Joint Dairy/Animal Science Meeting, Orlando, Florida July 14, 2015

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Take Home Message Number 8

Protect your investment with proper ensiling and feed-out management.

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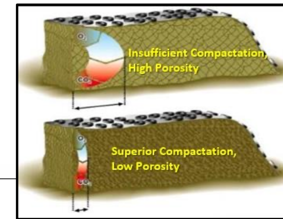
Compaction Density and Moisture (to prevent air porosity)



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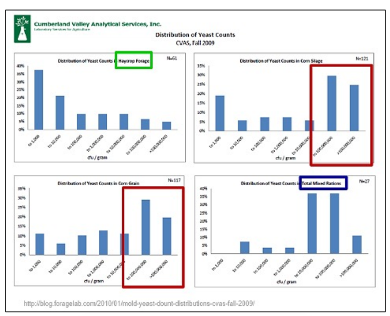
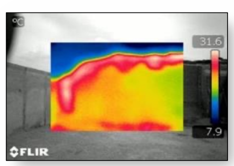
Corn Silage is Loaded with Yeast

Ranking crops in terms of difficulty to ferment (hardest to easiest)

- **HMC** with high yeast loads
- Extremely low moisture
- Extremely low sugar content
  - mostly starch
- **Alfalfa** wilted on the ground
  - ash and clostridial spores
- High buffering capacity
- Relatively low sugar
- **Corn silage** is direct cut
- Low buffering capacity
- High sugar
- Loaded with Yeast





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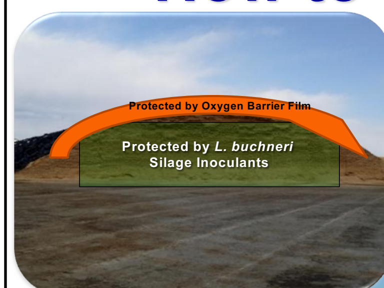
How to Stop Yeast



- ✓ Oxygen Barrier Film
- ✓ Crop specific *L. buchneri* inoculants

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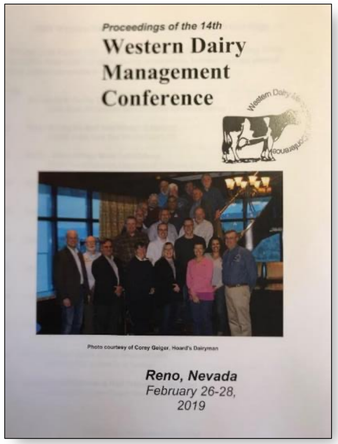

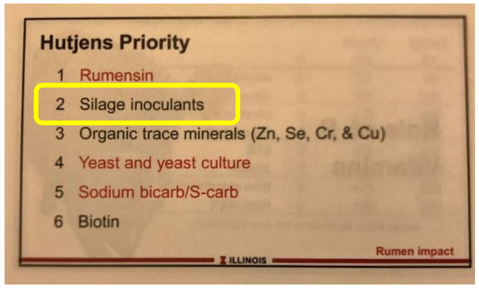
Hutjens Priority

1 Rumensin
2 Silage inoculants
3 Organic trace minerals (Zn, Se, Cr, & Cu)
4 Yeast and yeast culture
5 Sodium bicarb/S-carb
6 Biotin

Rumen impact

ILLINOIS

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Correct Bunker/Pile Face Management


http://easyrakefacer.com/

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Take Home Message Number 9

Talk to your nutritionist about the potential impact of:
- low rumen pH (caused by changes in ruminal starch digestion and
- excessive corn oil (linoleic acid) on butterfat yields.

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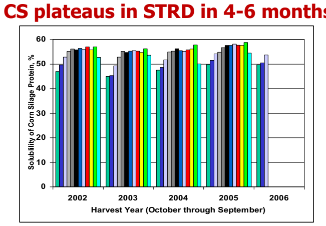
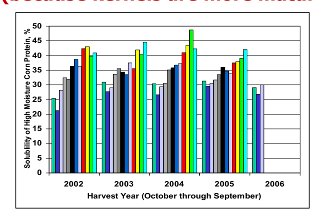
Corn Silage Increases in the Amount of Starch Digested in the Rumen Over Time in Fermented Storage

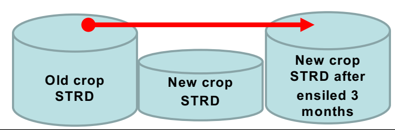
CS plateaus in STRD in 4-6 months



HMC increases for a full 12 months (because kernels are more mature)



- **Many dairies carry 14-16 months of corn silage inventory for:**
  - Hedge against agronomic (yield) risk
  - Ensure consistency in ruminal starch digestibility



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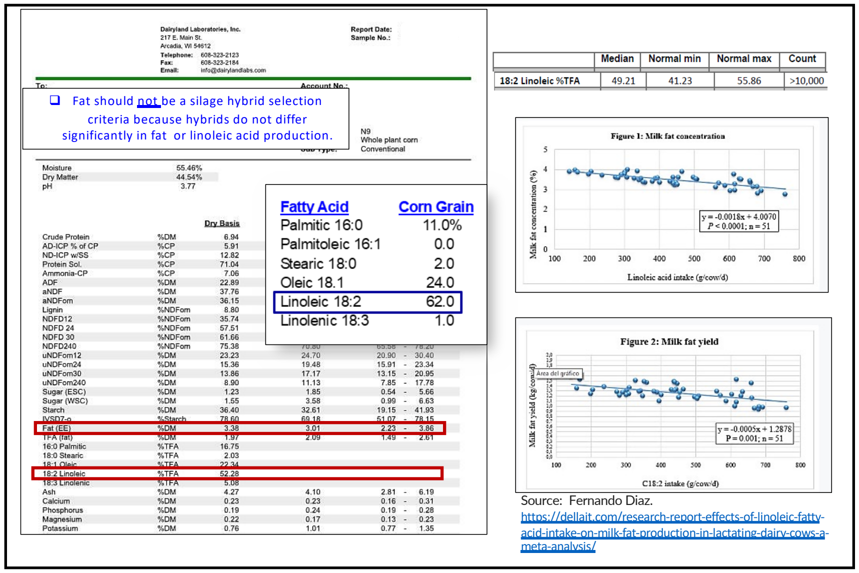
Fat should not be a silage hybrid selection criteria because hybrids do not differ significantly in fat or linoleic acid production.
Fatty Acid | Corn Grain
Palmitic 16:0 11.0%
Palmitoleic 16:1 0.0
Stearic 18:0 2.0
Oleic 18.1 24.0
Linoleic 18:2 62.0
Linolenic 18:3 1.0
Median | Normal min | Normal max | Count
18:2 Linoleic %TFA 49.21 41.23 55.86 >10,000
Figure 1: Milk fat concentration
y = -0.0018x + 4.0070
P < 0.0001; n = 51
Linoleic acid intake (g/cow/d)
Figure 2: Milk fat yield
y = -0.0005x + 1.2878
P = 0.001; n = 51
C18:2 intake (g/cow/d)
Source: Fernando Diaz.
https://dellait.com/research-report-effects-of-linoleic-fatty-acid-intake-on-milk-fat-production-in-lactating-dairy-cows-a-meta-analysis/

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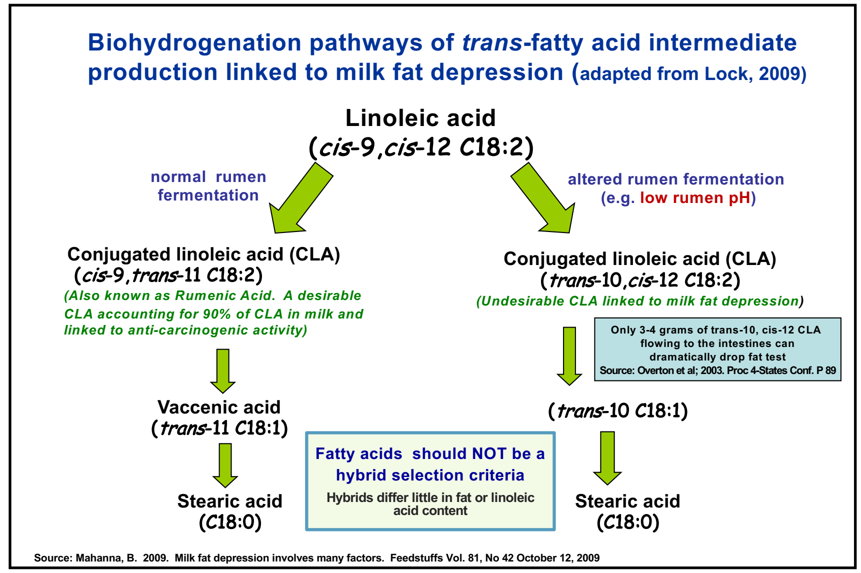
Biohydrogenation pathways of trans-fatty acid intermediate production linked to milk fat depression (adapted from Lock, 2009)
Linoleic acid
(cis-9,cis-12 C18:2)
normal rumen fermentation
altered rumen fermentation
(e.g. low rumen pH)
Conjugated linoleic acid (CLA)
(cis-9,trans-11 C18:2)
(Also known as Rumenic Acid. A desirable CLA accounting for 90% of CLA in milk and linked to anti-carcinogenic activity)
Conjugated linoleic acid (CLA)
(trans-10,cis-12 C18:2)
(Undesirable CLA linked to milk fat depression)
Only 3-4 grams of trans-10, cis-12 CLA flowing to the intestines can dramatically drop fat test
Source: Overton et al; 2003. Proc 4-States Conf. P 89
Vaccenic acid
(trans-11 C18:1)
(trans-10 C18:1)
Fatty acids should NOT be a hybrid selection criteria
Hybrids differ little in fat or linoleic acid content
Stearic acid
(C18:0)
Stearic acid
(C18:0)
Source: Mahanna, B. 2009. Milk fat depression involves many factors. Feedstuffs Vol. 81, No 42 October 12, 2009

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Take Home Message Number 10
Analyze your silage and understand inventory needs.

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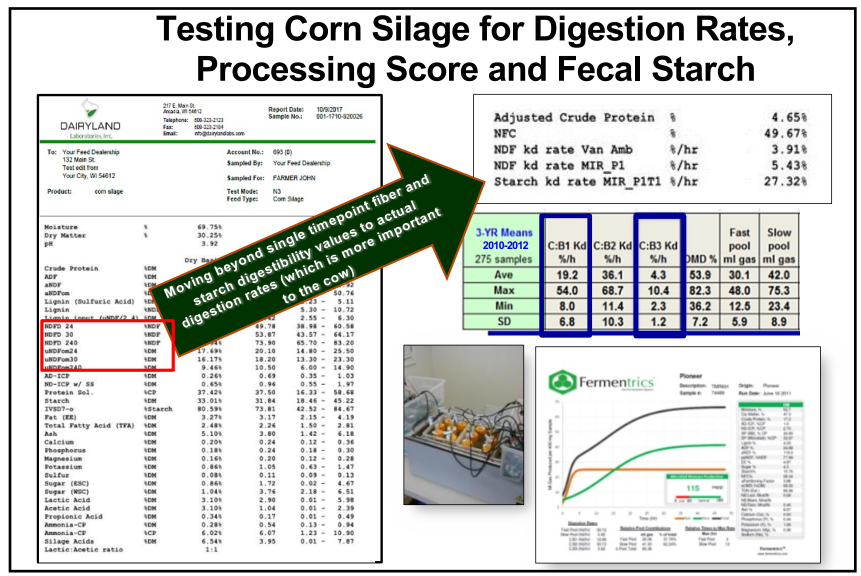
Testing Corn Silage for Digestion Rates, Processing Score and Fecal Starch
Moving beyond single timepoint fiber and starch digestibility values to actual digestion rates (which is more important to the cow)
Adjusted Crude Protein % 4.65%
NFC % 49.67%
NDF kd rate Van Amb %/hr 3.91%
NDF kd rate MIR_P1 %/hr 5.43%
Starch kd rate MIR_P1T1 %/hr 27.32%
3-YR Means 2010-2012 275 samples | C:B1 Kd %/h | C:B2 Kd %/h | C:B3 Kd %/h | DMD % | Fast pool ml gas | Slow pool ml gas
Ave 19.2 36.1 4.3 53.9 30.1 42.0
Max 54.0 68.7 10.4 82.3 48.0 75.3
Min 8.0 11.4 2.3 36.2 12.5 23.4
SD 6.8 10.3 1.2 7.2 5.9 8.9
Fermentrics

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Thank You…
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