Genetic and Environmental Factors Impacting Corn Silage Fiber Digestibility

BMR-like Claims

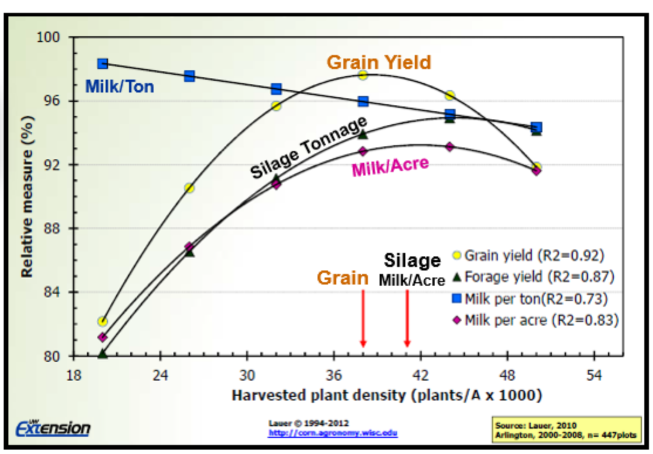
Some companies are claiming they can produce corn silage with similar fiber digestibility (NDFD) to BMR by increasing stalk diameter as a result of significantly reducing plant populations as low as 24,000 plants per acre (ppa). This document will address research findings related to this theory that a standard hybrid can be manipulated to exhibit the NDFD and dry matter intake potential of BMR genetics.

Don't Forget Yield

While NDFD is certainly important to cow performance, silage yield is also a major economic driver especially on dairies with a limited land base from which to harvest and transport forages.

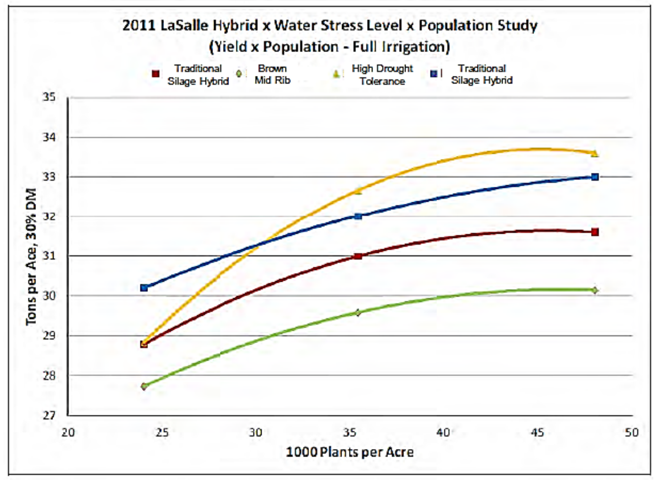
There is typically greater silage yield potential to be found through higher plant populations as documented in many university studies (Ferreira and Teets, 2017). Of course, optimum plant population varies by soil type, soil fertility, water availability, and plant genetics. Figure 1 shows results from 2000-2008 University of Wisconsin corn silage trials indicating that corn grain yield was maximized at 38,000ppa while corn silage yield was maximized at 44,000 plants per acre and corn silage milk/acre was maximized at 41,000ppa. Milk per ton was maximized at 18,000ppa but it is unlikely any dairy could sacrifice that much yield by planting at such a low population, even if planting ear-flexing hybrids.

Figure 1. Relationship between corn plant density and grain yield, silage yield, milk per ton and milk per acre (Lauer, 2009).



BMR silage genetics show a similar trend in terms of yield increasing with increasing plant population as demonstrated in a 2011 Pioneer research study (Figure 2).

Figure 2. Relationship between corn hybrid planting population and silage yield (Soderlund, 2011).



Impact of Plant Population on NDFD

Some studies have shown a small but biologically insignificant reduction in NDFD with increasing plant population. A summary of Pioneer silage hybrid studies from 2004-2007 show that 24-hour NDFD was reduced by 1-percentage point in hybrids planted from 18,000 to 42,000ppa (Jeschke and Curran, 2008, Figure 3). This small decrease would have no impact on cow performance, even if corn silage was the primary forage in the diet.

Figure 3. Effect of planting density on corn silage nutrients including 24-hour NDFD (Jeschke and Curran, 2008)

Plants/ acre	ADF	NDF	DigFib	Starch	CP
	------------------------ DM basis------------				
18,000	22.6	39.8	46.5	30.7	7.2
24,000	22.9	39.8	46.3	30.6	7.4
30,000	23.1	40.1	45.6	31.2	7.2
36,000	23.1	39.9	45.1	32.0	7.2
42,000	23.8	41.0	45.4	30.6	7.1

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A more recent 2017 study by Ferreira and Teets (2017) examined two different standard hybrids planted in seven different fields at 55,000, 70,000, 85,000 and 100,000 plants per hectare (23,000, 29,000, 35,400, 41,600 ppa). 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).

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

	Planting density[1]					$P <$[2]		
Item	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).

	Planting density[1]					$P <$[2]		
Item	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 2-year study at the Cornell University (Aurora) Research Farm in 2008 and 2009 evaluated two Pioneer (34T55 and 34A89), two DeKalb (DKC61-69 and DKC63-42), two leafy (TMF2Q716 and 2W587, Mycogen), and two brown midrib (F2F566 and F2F610, Mycogen) hybrids at planting rates of 25,000, 30,000, 35,000, and 40,000 kernels/acre (Figure 6). The researchers concluded that the DeKalb, leafy, and brown midrib hybrids had their highest yield at 35,000 kernels/acre with no real detrimental effect on NDFD and starch concentrations, whereas the Pioneer hybrids yielded best at 40,000 kernels/acre without negatively impacting NDFD (Cox et al., 2009).

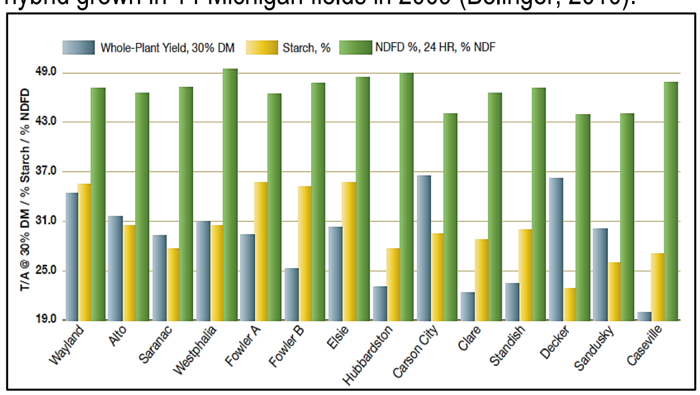
Figure 6. Planting rate effects on silage NDF, 30-hour NDFD, crude protein and starch of various corn hybrids averaged across the 2008 and 2009 in Aurora, NY (Cox et al., 2009).

	HYBRIDS							
	Pioneer	DeKalb	Leafy	BMR	Pioneer	DeKalb	Leafy	BMR
PLANTING RATE	NDF				NDFD (30 hr)			
Kernels/acre	------------------------%-------------------				------------------------%------------------------			
25,000	39.8	39.5	40.1	41.3	58.7	58.3	58.7	71.2
30,000	40.8	39.9	41.4	41.1	59.3	57.7	59.1	72.3
35,000	40.9	39.9	40.4	41.1	57.9	57.2	59.6	72.2
40,000	**41.4**	**40.6**	**42.0**	**42.5**	59.3	57.4	59.5	73.0
Avg.	40.7	39.9	40.9	41.5	58.8	57.6	59.2	72.2
	CP				STARCH			
25,000	**8.9**	**8.6**	**8.8**	**8.8**	33.3	34.6	34.6	33.3
30,000	8.5	8.3	8.6	8.6	34.2	34.6	34.5	32.1
35,000	8.3	8.3	8.4	8.5	33.9	34.9	34.8	32.6
40,000	8.2	8.1	8.2	8.4	33.8	34.7	34.0	31.5
Avg.	8.5	8.3	8.5	8.6	33.8	34.7	34.5	

Impact of Growing Environment on NDFD

The significant impact of growing environment, especially the influence of precipitation and soil water holding capacity, is well documented (Mahanna, 2010). Figure 7 illustrates the range in NDFD that one hybrid can display depending upon the unique growing environment. **It is a misrepresentation of hybrid differences for any company to compare yield, starch or NDFD of hybrids not grown in the same location.**

Figure 7. Yield, starch content and 24-hour NDFD of the same hybrid grown in 14 Michigan fields in 2009 (Bolinger, 2010).



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