The Relationship Between Grain Yield and Silage Yield in Field Corn in Northern Illinois

INTRODUCTION

Corn silage is an important ingredient in dairy and beef rations. Acres of Illinois corn harvested for silage in 2004 were 110,000 and the yield was 20 tons per acre (Illinois Agricultural Statistics, 2005 Annual Summary).

Determining a fair price for corn silage is difficult due to the many variable factors involved with this commodity. One approach has been to price corn silage based on grain value. In the past, a ton of corn silage standing in the field has been valued at 6.5 to 7 times the market price of a bushel of corn (6.5 to 7 bushels of corn grain per ton of silage). For stored silage, a value of 10 times the market price of a bushel has been used.

With genetic improvements that have been made in the yield potential of hybrids, the guideline for the number of bushels of grain per ton of silage may need to be adjusted upward. This study was conducted to determine if such an adjustment is warranted.

MATERIALS AND METHODS

A 3-year study (2002-2004) to determine the relationship between grain yield and silage yield in field corn was conducted at the Northern Illinois Agronomy Research Center, Shabbona (DeKalb County) on Flanagan silt loam (154) soil.

10 "grain" hybrids (Table 1) ranging from 103- to 113-day maturity were planted each year in eight, 30-inch rows with four replicates. Stands were thinned to 32,000 plants per acre.

Table 1. Hybrids grown by year.

Hybrid	2002	2003	2004	Hybrid	2002	2003	2004
Asgrow 718 RR/YG	X	X	X	Pioneer 33G26	X	X	X
DeKalb 53-34 RR/YG	X			Pioneer 34B23	X		
DeKalb 58-78 YG	X			Pioneer 34B24 YG		X	X
DeKalb 58-80 RR/YG		X		Pioneer 34M95 YG			X
DeKalb 60-12 YGRW			X	Pioneer 35NO5 YG	X		
Golden Harvest 8906	X	X	X	Pioneer 36B08		X	X
LG Seeds 2533	X	X	X	Syngenta 60-N2		X	
Pioneer 33G29 YG/LL			X	Syngenta N45-T5	X	X	
Pioneer 33G30 YG	X	X	X				

The previous crop was soybean. The corn received 180 pounds of nitrogen per acre either preplant or early side dress. Planting dates were May 8 (2002), April 29 (2003), and May 3 (2004). The middle two rows of the four rows on one side of each plot were harvested for silage yield, and the middle two rows of the other four rows in the plot were harvested later for grain yield. Silage harvest dates were September 13 (2002), September 18 (2003), and September 21 (2004). Plants for silage yield were hand-harvested, leaving a 6-inch stubble, and processed

using a “chipper shredder” (Sears brand, 8.5 horsepower) to simulate a forage chopper. Prior to chopping, the kernel milkline in two ears per plot was visually estimated. A “grab” sample was collected for near infrared reflectance spectroscopy (NIRS) analysis. Grain yield data were taken by machine harvest.

RESULTS AND DISCUSSION

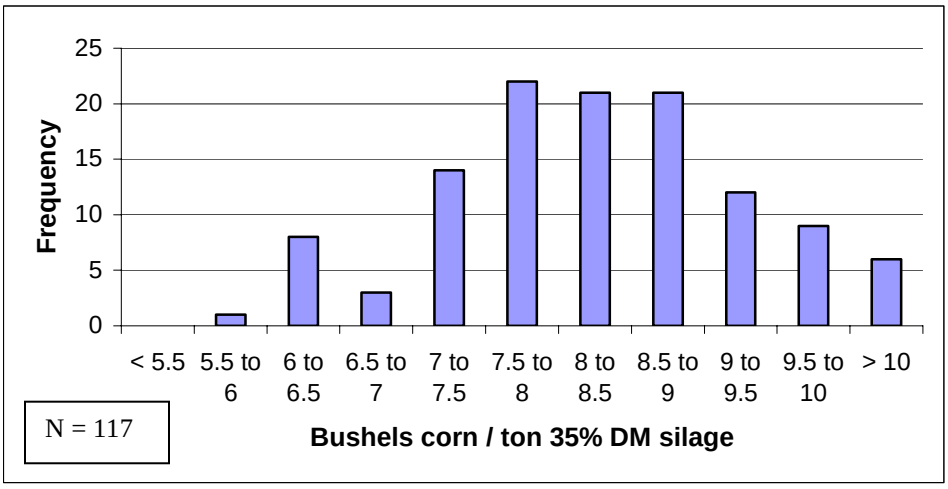
Grain and silage yield averaged over all hybrids and years are shown in Table 2.

Table 2. Grain and silage yield.

Factor	Average Value	Range
Bushels of corn grain (15% moisture) per ton (35% dry matter) of corn silage	8.3 bu./ton	5.8 to 11.4 bu./ton
Bushels of corn grain (15% moisture) per ton (100% dry matter) of corn silage	23.7 bu./ton	16.4 to 30.0 bu./ton
Corn grain yield (15% moisture), bushels per acre	208.4 bu./acre	161.7 to 258.6 bu./acre
Corn silage yield (35% dry matter), tons per acre	25.5 tons/acre	19.1 to 38.3 tons/acre
Corn silage yield (100% dry matter), tons per acre	8.9 tons/acre	6.7 to 13.4 tons/acre

64 (55%) of the observations had between 7.5 and 9 bushels of corn grain (15% moisture) per ton of 35% dry matter silage (Figure 1).

Figure 1. Distribution of bushels of corn per ton of silage (35% dry matter) over all plots.



Silage quality results averaged over all hybrids and years are shown in Table 3.

Table 3. Silage quality averaged over hybrids and years.

Trait	Average Value	Range
Dry matter, %	42.5	28.8 to 54.2
Crude protein, %	6.9	4.6 to 8.9
ADF, %	22.9	16.7 to 29.7
NDF, %	42.6	32.5 to 53.9
Lignin, %	2.19	1.39 to 3.54
IVDMD, %	72.5	64.1 to 78.4

Five of the total of ten hybrids grown were in the study all three years (Table 1). Although the objective of the study was not to compare hybrids, statistical analysis (SAS and the resulting LSD, 0.05) revealed the following about these five hybrids (data not shown but available from the lead author).

- There was no significant difference between the hybrids in yield of 35% dry matter silage and cell wall digestibility.
- Significant differences among these five hybrids existed for grain yield, 100% dry matter silage yield, bushels of grain per ton of silage, and silage quality.

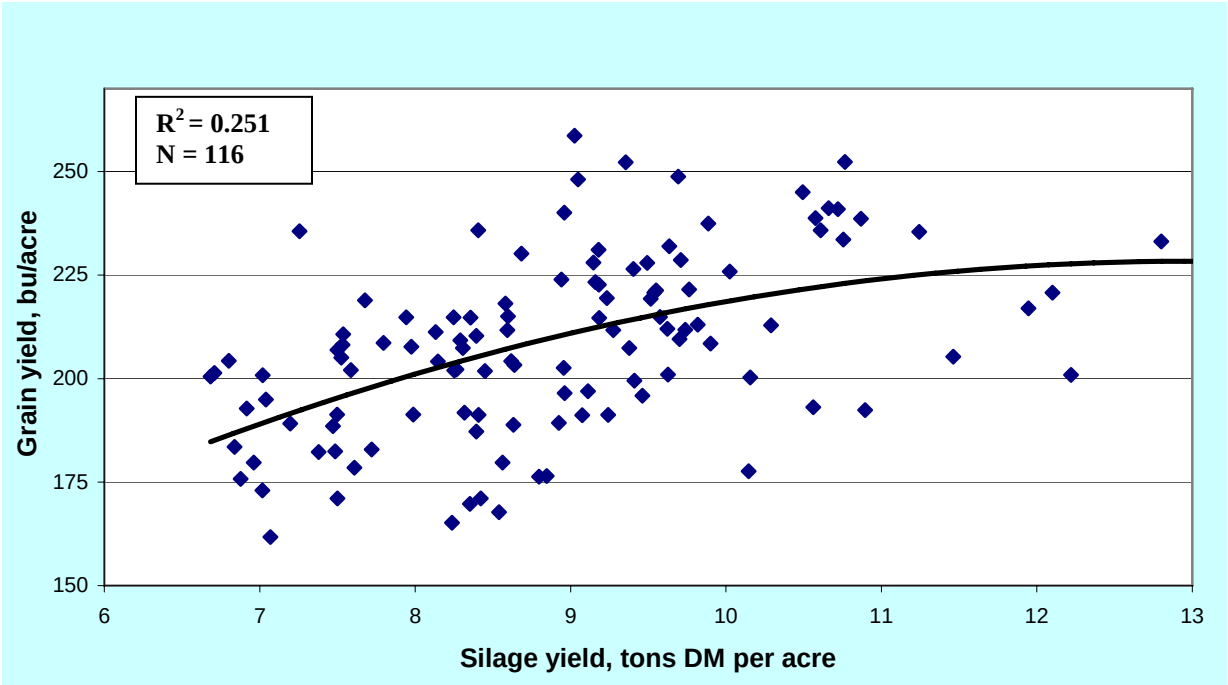
For all hybrids, silage quality traits were not highly correlated to grain yield and silage yield (Table 4).

Table 4. Correlations between silage quality traits and yield.

Quality and Yield Traits	Correlation (r)
Silage moisture to silage yield (tons/acre)	-0.349
Crude protein to silage yield (tons/acre)	-0.019
ADF to silage yield (tons/acre)	0.006
NDF to silage yield (tons/acre)	0.056
IVDMD to silage yield (tons/acre)	-0.115
Cell wall digestibility to silage yield (tons/acre)	-0.115
Cell wall digestibility to grain yield (bu./acre)	-0.283
Starch (%) to silage yield (tons/acre)	0.027
Starch (%) to grain yield (bu./acre)	0.219

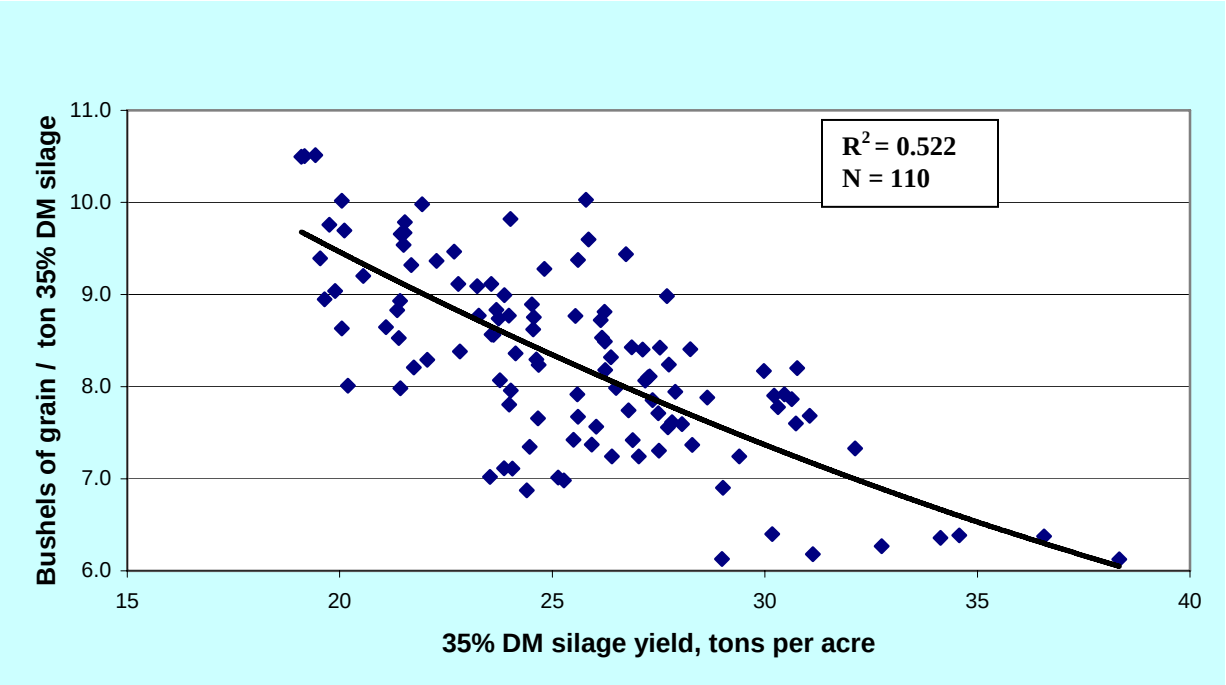
The correlation of grain yield to silage yield per acre for all hybrids was 0.500 (Figure 2).

Figure 2. Correlation between grain yield and silage yield in individual plots.



The correlation of bushels of grain per ton to silage yield per acre was -0.723 (Figure 3).

Figure 3. Correlation between bushels of grain per ton of silage and silage yield.



SUMMARY AND CONCLUSIONS

Data from ten corn "grain" hybrids grown for 3 years reconfirmed the fact that whole plant moisture cannot be accurately predicted from the location of the kernel milkline (r = -0.346).

Silage quality traits were not highly correlated with grain yield or silage yield.

The correlation of grain yield to silage yield was 0.500, indicating that choosing a hybrid for high grain yield tended to mean higher silage yield, but that is relationship is not very strong.

The strong negative correlation between bushels of grain per ton and silage yield per acre (r = -0.723) indicates that hybrids with high silage yield do not increase their grain yields to match this higher tonnage.

Averaged over all hybrids and years, there were nearly 8.3 bushels of corn (15% moisture) per ton of 35% dry matter silage. The three-year median value was 8.2 bushels. The average grain yield was 208 bushels (15% moisture) per acre.

The study indicated that in high yielding environments in northern Illinois, the guideline of 6.5 to 7 bushels of shell corn per ton of corn silage (35% dry matter) should be increased to 8 to 8.25 bushels per ton, especially for hybrids that produce high grain yields. However, 23% of the samples had more than 9 bushels per ton, and 22% of the samples were less than 7.5 bushels of shell corn per ton of silage.

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