Calculating Grain Yield Utilizing a Corn Silage Forage Test

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Introduction

Routine laboratory forage analysis of corn silage typically includes percent starch determination for the feed. Nutritionists utilize this information to partition Non-Fiber Carbohydrate (NFC) portions into % starch, % sugar and other NFC components to optimize production and animal health. A recent survey of laboratory corn silage sample results indicated a wide range of starch levels in corn silage (14-59 %.)¹ Factors such as hybrid selection, plant maturity at harvest and growing season can greatly affect the starch content of corn silage. In contrast US #2 shell corn is a standardized product. The definition of USDA corn grades are based on color, bushel weight, moisture level, presence of foreign material and broken kernels.² Even though starch content is not a part of the definition of corn grain the starch level is very consistent. Utilizing corn silage starch analysis and silage yield information can make estimation of equivalent grain yield much more accurate than was previously possible.

How much does grain per ton of silage vary?

Grain per ton of 65% silage ranged from 0 to 11 bushel per ton for individual samples in a UW study. Previous studies have shown an increase in grain per ton of silage for traditional grain hybrids as silage tonnage per acre increased. Jorgensen and Crowley found 5 bushel of grain per ton in lower yielding corn (less than 90 bushels per acre) and 7 bushel of grain per ton of corn silage in corn yielding over 150 bushel per acre. Lauer found extremely low yielding corn (25 bu./acre) averaging only 3.5 bushel per ton of 65% moisture silage. At about 150 bushel per acre silage averaged about 8 bushel of grain per ton. There was little increase in grain per ton above 200 bushel/acre grain yield (28 ton/acre of 65% moisture corn silage.) Individual samples had grain yields approaching 11 bushel of grain per ton of 65% moisture silage.

corn silage (62 to 68 p	ercent moisture).			
Yield of corn grain	Bushels of dry grain equivalent/Ton of Silage			
Bu/A	Bu/T			
Less than 90	5.0			
90-110	5.5			
110-130	6.0			
130-150	6.5			
Over 150	7.0			
Derived from "Corn sil	lage for Wisconsin cattle" - A1178 by Jorgensen and Crowley, 1972			

 Table 1. Approximate bushels of dry grain (15.5 percent moisture) contained in a ton of corn silage (62 to 68 percent moisture).

 Table 2. Approximate bushels of grain contained in a ton of corn silage during 1997 and

 1998.

	Silage at 65% moisture		Silage at 0% moisture	
Grain Yield at 15.5% moisture	Silage yield	Grain equivalent per Ton of silage	Silage yield	Grain equivalent per Ton of silage
Bu/A	T/A	Bu/T	T/A	Bu/T
25	7.1	3.5	2.5	10.0
50	9.0	5.5	3.2	15.8
75	11.1	6.8	3.9	19.2
100	13.4	7.5	4.7	21.3
125	15.9	7.9	5.6	22.4
150	18.7	8.0	6.6	22.8
175	22.2	7.9	7.8	22.4



Lauer, 2005

Considerable variation in grain per ton of silage exists within traditional hybrids. Silage yield can explain about 70% of the variation in grain per ton. The method in the UW study obtained silage yield at the appropriate harvest stage for silage and left the remainder of the plot to full maturity for measuring grain yield. Plant physiology indicates that some increase in grain yield would occur after silage maturity. This study slightly overestimates the actual grain yield per ton of silage if the grain had been harvested at the same time as ensiling.

Recently a wider variety of genetics have been used to produce corn silage. Some producers select hybrids that have higher forage to grain ratios than do traditional grain hybrids (silage specific hybrids.) The grain characteristics of some of these hybrids may differ as well; energy dense, high oil, soft endosperm; ethanol production adapted hybrids are all marketed. Selection of longer day maturity hybrids for silage has become more common. All of these practices may result in more variation (typically less grain per ton) than what is found among traditional grain hybrids capable of reaching physiologic maturity in the area of the study.

How important is accurate grain per ton estimation?

Current USDA-Farm Service Agency programs allow producers of silage to claim Loan Deficiency Payments (LDP) for the grain in the silage as soon as the crop is harvested. This practice requires the estimation of grain yield based on the harvested silage. Timeliness of this estimation is also important because the estimation must be done prior to feeding of the silage. The LDP rate varies daily and sometimes is lowest early in the harvest season. This makes it desirable to accurately estimate the grain yield as soon as the corn silage is harvested.

This estimation may also be utilized between producers to place a value on the standing crop or harvested forage. It may be used for hybrid selection to estimate the grain yield on a hybrid harvested as forage.

How can the corn silage starch test be used to estimate grain yield?

All that is needed is the yield of corn silage and the starch analysis. Corn Grain is 72% starch on a dry matter basis. The grain is the only source of starch in the silage. If the total yield of starch can be determined it can be directly converted to grain. An example would be a field that yielded 25 ton of 65% moisture forage. A forage test indicates the silage contains 33% starch. The dry matter yield of starch is:

DM starch yield = as fed silage yield x % dry matter x % starch (DM Basis)

(example)	= 25 ton x 2000 lbs/ton x .35 (1-moisture) x .33	
	= 5,775 lbs starch	
Grain yield	= lbs. starch/ (%starch content) / (DM % of shell corn/56 l	bs/ bu.
(example)l	= <u>5775 lbs. Starch/ .72/ .845</u>	56
	= 169.5 bushel/ acre	
or simplified	= lbs. starch x .0293	

How can the silage starch test estimation of grain yield be used?

The results of this estimation are accurate for the yield on the date of harvest as corn silage. This information can help dairy herd managers estimate the amount of supplemental corn that will be needed to feed the herd prior to the grain harvest. It is an accurate estimation of the actual grain yield and should be used for reporting grain yields for FSA programs such as Loan Deficiency Payments (LDP) or to establish crop yield history for crop insurance. It is less useful for comparing hybrid performance between varieties that are harvested for different purposes. Unless efforts are made to estimate the extra starch accumulation that occurs between the silage harvest date and the harvest of the same hybrid for grain, the silage harvested varieties will be underestimated. Factors such as late season health or standability are not easily evaluated on hybrids harvested for silage.

Frost damaged corn has a value for silage; however it may not produce any marketable grain. Frost damaged silage in the dough through dent stage will have some starch content. It is questionable even if this value is low if it is appropriate to convert this to a grain equivalent, because none of the crop can actually be utilized as grain.

What factors influence accuracy of the estimation?

In field conditions the estimation of gross tonnage of corn silage is often the biggest source of error. Loads of silage delivered to the silo must be weighed and counted. Wagons or trucks may be of different size and filled to different degree. It is important to weigh a significant number of loads to establish accurately the weight of silage delivered to the silo. Alternately the volume of the silage mass in the pile, bag, bunker or tower can be estimated and combined with a measurement of average density to come up with gross yield of silage. The volume of irregular shaped piles is difficult to measure and density is often not uniform. Tower silos need time to settle to estimate the settled volume of feed.

If per acre information is needed the accuracy of the size of the field is an important factor.

Corn silage is often more consistent than hay crop forages, but variability does occur. If the silage varies in moisture or starch content due to maturity, field conditions or variety the feed should sub sampled and a weighted average used to determine total yield or estimate the yield of each lot separately. Laboratory tests will provide moisture and starch levels quite accurately for the samples provided.

Summary

Starch analysis is a useful, inexpensive, fast and convenient tool to more accurately estimate the grain of yield of corn harvested as silage.

- 1. UW Soil and Forage and Soil Laboratory; Forage Data Base May 18, 2007 Internet Webpage: <u>http://uwlab.dyndns.org/marshfield/</u>
- 2. Official United States Standards for Grain. USDA. Ag. Marketing Service, Grain Division



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