



Considerations in Managing Cutting Height of Corn Silage

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INTRODUCTION

Corn silage is an important forage source, and usually accounts for 30 to 40% of the diet for dairy cows on many Pennsylvania farms. Recently, interest has developed in cutting corn silage higher during harvest to improve the forage quality. Cutting corn silage higher can increase silage quality because the lower part of the crop is poorly digestible, but this can also reduce yield. Is the improved quality large enough to offset the yield loss and further increase the profitability of the dairy? What factors should be considered before choosing to cut corn higher? The objective of this publication is to provide some insight into these issues.

NUTRITIONAL CHANGES

We summarized the results of 11 cutting height studies found in the recent scientific and popular literature (Antos et al., 2002; Cox et al., 2003; Curran and Posch, 1999; Cusicanqui, 1998; Dominguez et al., 2002, 2003; Neylon and Kung, 2003; Pitzen, 2000; Sass, 1996; Shirk, 2001; Wu et al., 2001) (Table 1). These studies examined the effect of increasing the cutting height on the yield and nutritional value of

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	4.7
DM digestibility, % ²	78.6	80.6	2.5
Yield, ton/ac, DM	8.1	7.5	-7.4
Milk equivalent ³			
lb/ton	3014	3162	5.2
lb/ac	20990	20610	-1.7

¹Antos et al., 2002; Cox et al., 2003; Curran and Posch, 1999; Cusicanqui, 1998; Dominguez et al., 2002, 2003; Neylon and Kung, 2003; Pitzen, 2000; Sass, 1996; Shirk, 2001; Wu et al., 2001. Not all of the studies reported every measurement.

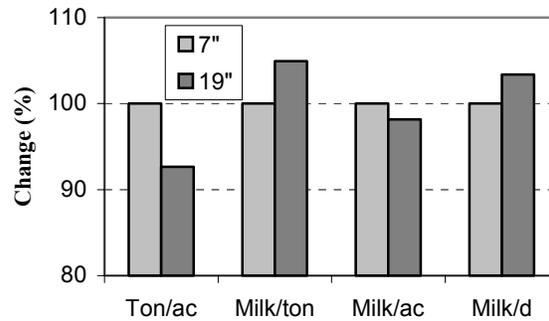
²In vitro estimates.

³Calculated using the spreadsheet program Milk 2000, developed by the University of Wisconsin, assuming both silages were processed.

corn silage. The cutting height used in these studies averaged 7" for the low level, and 19" for the high level. With the higher level, dry matter (DM) and starch content of the harvested corn silage increased by about 2 percentage units each or 6%, and the acid detergent fiber (ADF) and neutral detergent fiber (NDF) content decreased by 7 to 10%. Estimated digestibility of NDF and DM also increased, although slightly. These changes occurred because the ear is usually drier than the leaves and stalk, and the lower internodes of the corn plant are more fibrous and less digestible than the middle or upper internodes. The yield of corn silage was reduced by 7.3% on average when cut higher. Estimated potential milk per ton of corn silage using the Milk 2000 spreadsheet increased with high cut, reflecting improved quality, while milk per acre decreased

slightly, as a result of the trade-off between increased quality and reduced yield. Figure 1 shows these potential production changes, along with the milk production change observed in two feeding trials, as discussed below.

Figure 1. Cutting height trade-off



ANIMAL PERFORMANCE

While laboratory analyses are important for revealing the nutritional changes, animal performance is the ultimate test of the validity of high cutting of corn silage. Several feeding trials have been conducted. Two of the trials compared low cut and high cut corn silage included in diets on an equal forage basis, regardless of the energy content of the silages. The first study was conducted at the US Dairy Forage Research Center and University of Wisconsin (Wu et al., 2001). Whole corn plant was cut at 14 or 20" above ground. The low cut was higher than planned, resulting from difficulties in mechanical control. The corn silage yields were 7.0 and 6.6 ton/ac on a dry matter basis for the low and high cutting heights, respectively. Corn silage of each type was included in the diet for lactating cows as 40% of the dry matter. The second study was reported by Neylon and Kung (2003) at the University of Delaware. Corn silage was cut at 5 or 18" off ground, resulting in dry matter yields of 7.4 and 7.0 ton/ac. The silages were included in the diets also at 40%.

In both studies, dry matter intake was not affected by cutting height, while milk yield increased for the higher cut diet (Table 2). The increases in milk yield were similar, averaging 3 lb/d (from 87 to 90 lb/d). Milk fat content,

Table 2. Results of two feeding trials using corn silage harvested at different heights of cut.

Item	Wu et al. (2001)		Neylon and Kung (2003)	
	14"	20"	5"	18"
Dry matter intake, lb/d	45.8	43.6	55.9	56.3
Milk, lb/d	74.6	77.2	99.4	102.7
Milk fat, %	3.74	3.39	3.26	3.03
Milk protein, %	3.11	3.12	2.84	2.89

however, decreased for the high cut diet in both studies, with the reduction averaging 0.3% unit. Milk protein content was not affected. These results would suggest that the net benefit of feeding high chop corn silage when substituted in the ration for conventional silage is minimal.

Two other studies (Dominguez et al., 2002; Dominguez and Satter, 2003) evaluated low or high chop corn silage in rations that were formulated on an equal NDF basis. In these studies, whole plant corn was cut at 8 to 9" or 26 to 28". In both studies, 3% less grain was used in the diets that contained the high chop corn silage because the NDF content of the silage was lower than that of the low chop silage. Neither milk yield nor milk fat content was affected by diets. These results suggest that high cut corn silage may allow less grain or more forage to be included in the diet without affecting milk production.

ECONOMIC CONSIDERATIONS

An economic analysis of cutting corn silage at different heights using the average data from Wu et al. (2001) and Neylon and Kung (2003) is shown in Table 3. The analysis shows that much of the benefit of the increased milk production (from 87 to 90 lb/d) obtained from feeding the high cut silage is offset by the effect of the lower milk fat percentage (0.3 percent unit) on milk price. When the loss in silage value due to a lower harvest yield is considered, the net effect on a per acre basis would be slightly negative, resulting in an average loss of \$9/ac. This result is similar to the positive effect on milk/ton but a slight negative effect on milk per acre predicted using the Milk 2000 spreadsheet.

Table 3. Economic analysis of increasing cutting height of corn silage for dairy cows using average data from two feeding trials (Neylon and Kung, 2003; Wu et al., 2001).

Gain	Loss
Using a milk increase from 87 to 90 lb/d and a milk fat decrease of 0.3% units, and assuming a milk price decrease from \$12.00 to 11.64/cwt (\$0.12 to 0.1164/lb) due to lower fat, the increased income in milk $= \$0.1164 \times 90 - \$0.12 \times 87 = \$0.04/\text{d}$ DMI average: 50.4 lb/d $\times 40\%$ from corn silage = 20 lb/d Gain due to corn silage: $\$0.04/20 = \$0.002/\text{lb}$ \times corn silage yield: 13,400 lb/ac (6.7 ton/ac) $= \$27/\text{ac}^1$	7.2 ton/ac for low cut - 6.7 ton/ac for high cut $= 0.5 \text{ ton/ac}$ Cost of corn silage: \$71.4/ton of DM (\$25/ton, 35% DM) $\times 0.5 \text{ ton/ac}$ decrease due to higher cutting $= \$36/\text{ac}^1$

¹Net loss = 36 - 27 = \$9/ac.

When we estimated returns using a lower level of milk production (58 lb/d), with similar changes in milk production and fat content, we found that the loss increased to \$23/ac. On the other hand, if the decrease in milk fat content were only 0.2% instead of 0.3% unit, then net returns would be positive, averaging \$58/ac for the higher production level (87 lb/d) and \$31/ac for the lower production level (58 lb/d). It seems that the response to high cut corn silage varies with the herd production level and changes in milk fat content. High cut corn silage would be most beneficial when fed to high producing herds and under conditions where milk fat can be maintained, as seen when high forage diets are fed.

Another way to evaluate the high cut corn is to estimate the effect on ration costs. Based on our summary, the estimated NE_L for high chopped corn was 0.74 compared to 0.71 Mcal/lb for conventionally chopped corn. Accordingly, substituting high cut corn silage in the dairy ration should result in an opportunity to reduce grain supplementation, as done in the two studies mentioned above (Dominguez et al., 2002; Dominguez and Satter, 2003). We estimated the change in the cost of rations formulated with either conventional or high chop corn silage (Table 4). We could use almost 6% more corn silage or 6% less corn grain for the high chop diet, while maintaining the same NE_L content as the conventionally cut corn silage diet (0.76Mcal/lb). We assumed a price of \$30/ton for conventional corn silage, an 8% higher cost for the high chop silage with 0.03 Mcal/lb more NE_L and 0.2 percent unit higher CP, and \$3.00/bushel for corn. This analysis showed that the feed cost would be 7 cents per cow per day less for the high cut diet. The high cut diet also had a higher forage content, which should be beneficial for milk fat content and herd health.

Table 4. Cost comparison of feeding a diet using high cut corn silage and a diet using low cut corn silage plus corn on an equal energy basis.

Item	Ration 1: 7" cut corn silage	Ration 2: 19" cut corn silage
Corn silage, %	31.9	37.7
Corn, %	21.9	16.0
Alfalfa silage, %	21.5	21.5
Soy hull, %	5.2	5.2
Soybeans, roasted, %	7.8	7.8
Soybean meal, %	9.98	10.0
Mineral and vitamin mix	1.8	1.8
NE _L , Mcal/lb	0.76	0.76
CP, %	17.7	17.6
NDF, %	31.7	30.9
Feed cost, \$/d ¹	3.24	3.17
Feed cost, \$/100 lb of milk ¹	4.03	3.94

¹Price assumptions: \$30/ton for 7" cut corn silage, \$32.4/ton for 19" cut corn silage, and \$3.00/bu for corn.

OTHER CONSIDERATIONS

The decision to chop corn silage at higher levels is a farm specific question and is likely influenced by a number of other considerations.

Cutting silage at higher levels can be a tool for producers to manage the dry matter of the crop. Since harvesting silage a foot higher will generally increase dry matter in the harvested crop by 2% units (Table 1), producers could use this to harvest earlier. Because corn silage generally dries down at a rate of about 0.5%/d, this translates into approximately four-day earlier harvest. This would be important in working with a custom operator or managing harvest logistics. In other situations, where the crop is already too dry, it is probably best to harvest at the normal 6" height.

Chopping higher can also leave more residues in the field, improving soil erosion protection. However, this effect is likely small on fields that will be planted with a rye cover crop. One consideration on those fields is that some of the remaining stalks could be harvested with the

following year's rye crop, potentially reducing the forage quality of ryeilage harvested the next spring.

The response to cutting height may be influenced by several other variables. Some specialty hybrids may contain more sugar in the stalk or their stover fiber digestibility is high, and the quality response to increased cutting height may be less. For example, brown midrib hybrids have been reported to change little in quality to offset the impact on the yield (Antos et al., 2002; Cox et al., 2003). Another potential benefit with higher cutting is nitrate reductions in harvested material. This is particularly important in drought seasons.

High chop corn is probably most profitable where lactating animals are the consumers of corn silage, since dry cows and heifers are likely to be less responsive to the increased quality in the high chop corn.

Another consideration could be the effect on the inventory of forage. Particularly, if high chop corn silage or other forage sources are fed at a higher level, storage will need to be increased to meet the needs of the herd. If the storage capacity on the farm is already limiting, then higher chop and increasing the corn silage feeding level would exacerbate this problem.

CONCLUSIONS

Our analysis shows that in some situations higher cut corn silage can improve milk production when directly substituted in the ration but can also decrease milk fat content and the resulting net economic benefit is negative to slightly positive. Minimizing milk fat decrease is critical. When we switched from conventional to high cut silage and rebalanced the ration with more forage, there appeared to be a potential advantage of 7 cents per cow per day for the high cut ration. This is consistent with the reports that using high cut corn silage allowed more forage to be included in the diet with comparable milk production. In addition to reducing feed cost, this approach should also help maintain milk fat content, and therefore should be most suitable for using high chop corn silage.

Apart from increasing the energy content and nutrient digestibility, high chopping can be a tool to manage the dry matter content and harvest timing of corn silage. However, there are many other farm specific factors that can affect the profitability of the practice and should be considered. It is important that producers do their own analyses similar to those presented in this factsheet before making the switch to higher cut corn silage.

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