Extension
UNIVERSITY OF WISCONSIN–MADISON

Down corn silage harvesting and considerations

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Corn that has lodged or been knocked down is problematic for producers because it makes harvesting more difficult and can affect the nutritive value and fermentation profile of silage. Many weather events can blow or knock down corn, including hurricanes, hailstorms, severe thunderstorms, and others. Strong winds or precipitation such as hail can damage the stems of plants, lodging them. A severe example of this was observed in Iowa from the derecho that blew down several million acres of down this year (2020).

Figure 1. Corn fields affected by a derecho in IA. Picture courtesy of Ted Koehler, Syngenta Crop Protection LLC.

The degree that corn is affected by severe weather varies greatly depending on the conditions. Severe thunderstorms or moderate hail may cause lodging, but plants may just be leaning over. Conversely, strong winds or heavy hail may flatten plants. Regardless, lodging will likely increase yeast and mold contamination and affect nutritive value.

Corn in contact with the ground may be prone to undesirable bacterial and fungal growth, deterioration, and mycotoxin contamination. Additionally, contact with the ground will likely increase ash content in the forage. Besides, there is potential damage to the stalk or ears which could cause loss of ears, rapid plant drying or ear/stalk rot.

Despite these issues, the higher prices of purchased corn silage make harvesting down silage necessary for many dairy and beef producers. Knowing what to expect and what can improve down corn silage is important for producers that find themselves in this situation.

Harvesting Down Corn

If corn has been knocked down or lodged, fields should be surveyed to determine the extent of the damage, if debris is in the field, and the direction or pattern that plants were knocked down. Using a drone can make this process easier if one is available. Then crop insurance coverage options should be explored before trying to harvest any down corn.

If harvesting, the moisture content of down corn should be monitored closely. Because of the greater yeast and mold contamination with a likely reduction in nonfiber carbohydrates, it is important to harvest at a moisture content that promotes optimal fermentation (65% whole-plant moisture). Damaged plants affected by ear and stalk rot, or other diseases, will dry more rapidly than healthy plants. Also, corn that has been flattened

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may dry unevenly, with corn on top of the "mat" formed drying more quickly than the corn under it.

Harvesting will be easier if corn is knocked down to the same direction than if knocked down in multiple directions or in a circular pattern. In this case, the forage harvester should be driven against the direction that corn is laying in the field. But if the corn is not laying in the same direction, producers must pick the direction the most corn is laying and drive against it. The header of the harvester should be lowered based on how high off the ground the corn is. If it is flattened or almost flat, the header should be lowered as much as possible. Otherwise, the header should be lowered just under the corn so that it will pick up as much as possible.

Figure 2. An example of the direction a harvester should be driven in a field of down corn. Picture courtesy of Full Circle Dairy LLC.

Driving the harvester more slowly than usual can help prevent the header from being clogged, but if the corn is laying in multiple directions, the header may clog often. When clogged, the harvester should be reversed, turned off and any forage cleared from the front of the header. Even corn laying in the same direction will clog the harvester periodically, so harvesters should watch the header closely as they move through the fields.

Harvesting down corn is more time consuming and expensive than normal corn silage. This is because of the extra labor and higher fuel cost associated with the slower process. However, for farmers who struggle to produce enough silage to carryover for the next year, or those facing challenging financial times, harvesting down corn may be worth it in the long run.

Considerations for damaged corn silage

Separating down or damaged corn silage from any good quality silage being harvested is recommended because of the lower nutritive value and concerns for poor fermentation. If a farm usually uses a large bunker or drive over style silo, it may benefit from renting a bagger and using silo bags for down corn. Or, if there are large quantities of down corn, another separate bunker or drive over silo may be constructed.

Because more soil is being taken in by the harvester, more yeast and mold contamination and greater ash levels are expected. So, producers should inoculate the forage with a proven inoculant containing *L. buchneri* because these inoculants decrease yeast and mold growth during feed-out. This also improves aerobic stability, hygienic quality and prevents further DM losses or problems during feed-out.

Mycotoxin contamination is another concern. Because of this, sample the corn silage and evaluate mycotoxin risk, regardless of the perceived quality. Mostly importantly, if mycotoxins are detected, work with a nutritionist to mitigate the negative impact associated with feeding mycotoxin(s). Consider adding a research backed mycotoxin binding agent or health promoting ingredient to the ration. Alternatively, producers can adopt feeding strategies that minimize the amount fed per day.

Additionally, the nutritive value of down corn silage should be monitored because the plants are likely to differ in nutritive value relative to healthy corn, even from the same hybrid and field conditions. Damage to the stalk can lead to plants drying more rapidly, possibly decreasing the levels of sugars and related nutrients. Stalk damage can also promote stalk rot, increasing pre-ensiling losses. Similarly, damage can occur to the ears, leading to ear rot or loss of kernels, and ears can even fall off the plant all together, which decreases starch concentration.

In general, it is important to plan on down corn silage being mediocre to low quality. Depending on the nutritive quality, this may mean it needs to be fed in combination with good quality silage, so on average the TMR quality is acceptable. Even if the down corn silage is

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exceptional quality, planning on lower quality silage will make management decisions easier when it is time to start feeding the down silage.

Case Study 1 – Full Circle Dairy (2019)

Data from a single corn hybrid, which was grown under similar management practices in fields unaffected and affected by a severe thunderstorm, were used to perform this case study. The only exception is down corn was irrigated with wastewater prior to reaching silage maturity.

During the 2019 spring harvest, Full Circle Dairy LLC (Lee, FL) experienced a severe thunderstorm on July 3rd, 2019 that knocked down approximately 400 acres of corn approaching silage maturity. Unaffected and standing corn fields (**Control Corn**) were prioritized and harvested between July 13th and July 15th. Down corn was harvested between July 17th and July 21st, approximately two weeks after the storm.

Figure 3. Corn fields affected by a severe thunderstorm in North FL. Picture courtesy of Full Circle Dairy LLC.

Harvester settings (theoretical length of cut and kernel processor roll gap) were similar, except for cutting height and harvester speed, both of which were lower during the down corn harvest. Down corn was harvested as described before, by decreasing harvester speed and driving against the direction the corn was blown down.

All silage was inoculated with the same bacterial inoculant and packed into Ag-Bag silos with the down corn separated from the unaffected corn (total of 6 down corn silos and 8 control corn silos). Silos were managed similarly and stored for similar periods of time. Just before opening the silos, samples were collected with a drill probe by collecting a core from 5 to 7 separate spots down the length of the silo. All samples were then sent to a commercial laboratory and analyzed for fermentation profile, nutrient composition, in vitro NDF digestibility (ivNDFD) at 30 h, and in situ starch digestibility (isSD) at 0 and 7 h. These values were also used to predict energy content.

The average dry matter (DM) values for control corn at ensiling was 39.2% DM, while the average DM for down corn forage was 42.0% DM. These values are based on field averages for both the down and control corn.

Table 1. The fermentation profile of control and down corn silage in Florida.

Item	Control Corn	Down Corn	SE	*P*-Value
pH	3.86	4.02	0.03	0.001
Lactic Acid, % DM	4.6	3.5	0.18	0.001
Acetic Acid, % DM	2.1	2.3	0.18	0.25
Butyric Acid, % DM	-	-	-	-

The fermentation profile of control and down corn silage is in table 1. For control corn, the pH was lower and the lactic acid concentration greater than down corn. There was no butyric acid detected in any silages. Despite these findings, the differences between the control and down corn silage were minimal and likely a result of the lower WSC concentration slightly limiting lactic acid production in down corn. Nevertheless, based on these results, down corn can undergo adequate fermentation.

Table 2. The nutrient composition of control and down corn silage in Florida.

Item	Control Corn	Down Corn	SE	*P* – Value
CP, % DM	7.0	7.5	0.14	0.01
N-NH_3, % CP	7.1	8.5	0.6	0.01
ADF, % DM	20.8	25.0	1.16	0.004
NDF, % DM	36.7	41.4	1.85	0.03
Lignin, % DM	3.6	4.4	0.17	0.001
Starch, % DM	36.6	32.1	1.91	0.04
WSC, % DM	4.4	3.6	0.24	0.01
Ash, % DM	3.3	4.4	0.16	0.001

Table 2 shows the nutrient composition of corn silage. Down corn silage had greater concentrations of CP, ammonia, ADF, NDF, lignin, and ash. Conversely, control corn silage had greater levels of starch and WSC. Overall, this demonstrates down corn silage had a lower quality nutrient composition compared to control corn.

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However, some of these results may be confounded with the additional time the down corn spent in the field. Likely, the lower starch concentration is from damaged kernels or ears which increased the concentration of fiber and protein in down silage. The greater ash is likely from soil contamination.

Table 3. The digestibility of NDF and starch for control and down corn silage in Florida.

Item	Control Corn	Down Corn	SE	*P* - Value
30 h ivNDFD, % NDF	57.5	54.8	0.95	0.01
240 h uNDF, % DM	7.3	10.2	0.54	0.001
TTNDFD, % DM	37.1	39.8	1.06	0.02
0 h isSD, % Starch	35.0	44.9	0.86	0.04
7 h isSD, % Starch	87.5	85.3	0.86	0.06

Table 3 has the digestibility metrics of corn silage. Control corn had greater ivNDFD at 30 h which is likely related to the lower uNDF concentration. Surprisingly, down corn had greater total tract NDFD. Additionally, the down corn had a greater 0 h isSD, possibly due to more mature, brittle kernels being better processed with slower harvesting. However, the 7 h starchD tended to be greater for control corn, showing that overall starch digestibility was lower for down corn. Again, this is probably because of more mature kernels from the extra time spent in the field and the potentially more rapid drying rate in down corn plants.

Table 4. The predicted energy content, milk and beef production of control and down corn silage in Florida.

Item	Control Corn	Down Corn	SE	*P* - Value
Milk 2006 Predictions				
TDN, % DM	72.0	67.2	1.12	0.001
NE_L, Mcal/kg	0.71	0.65	0.01	0.001
NE_M, Mcal/kg	0.54	0.47	0.02	0.001
NE_G, Mcal/kg	0.83	0.75	0.02	0.001
Milk, kg/Mg	3340	2975	83	0.001
NRC Beef Predictions				
TDN, % DM	66.4	63.5	0.91	0.01
NE_M, Mcal/kg	0.60	0.69	0.91	0.01
NE_G, Mcal/kg	0.42	0.38	0.01	0.01
Beef, kg/Mg	237	208	9.5	0.01

Table 4 shows the predicted energy content of corn silage, and milk and beef per ton estimates. For the milk per ton predictions, down corn had lower levels of TDN, predicted energy content and predicted milk production. This is likely because of the greater starch concentration and ivNDFD combined with the lower ADF and lignin concentrations observed in control corn, all of which increase the energy available for cattle. Similarly, for the Beef NRC predictions, down corn had greater TDN, NE_G, and kg of beef per megagram silage. However, the predicted NE_M was lower for control corn than down corn.

Despite the differences observed in control and down corn silage, down corn silage still holds promise. Although this case study shows the quality can be lower than unaffected corn silage, the quality is still good enough for growers to consider harvesting down corn. Additionally, some of the results from this case study could be from the longer time down corn was left in the field, making down silage production even more promising.

Case Study 2 – Iowa farms (2020)

During the summer of 2020, Iowa experienced a derecho, commonly referred to as a "land hurricane." The strong winds knocked down several million acres of corn and may have affected up to 10 million acres of corn fields.

Figure 3. Corn fields affected by a derecho in IA. Picture courtesy of Ted Koehler, Syngenta Crop Protection LLC.

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Twelve, fresh, pooled samples were hand-collected directly from fields by Dr. Dahlke prior to machine harvest from the Story county Iowa fields and sent to Rock River Laboratory, Inc (Watertown, WI) for nutrient analyses two weeks after the actual wind event. A couple of points that may impact these results should be noted. First, the samples of down corn were cut at the same height, therefore leaving the same stubble height as the standing corn. If corn would have been machine harvested, this would not have happened because of the difficulties in picking up the down plants. Second, the standing (control) corn samples tended to have substantial leaf damage from the wind, while the down corn tended to have the leaf tissue more intact.

Table 5 shows the nutrient composition of corn forage in Iowa. There were no statistical differences in any of the nutrient composition metrics, although there are numerical differences for some variables. For example, the NDF concentration was numerically lower while the starch concentration was numerically greater for control corn. Greater starch content equates to greater energy per ton, and this could suggest there may still be small effects of down corn on nutrient composition.

Table 5. The nutrient composition of control and down corn forage in Iowa.

Item	Control Corn	Down Corn	SE	*P* - Value
DM, % as fed	42.9	40.5	2.23	0.47
CP, % DM	7.7	7.7	0.38	0.95
ADF, % DM	23.0	24.4	2.86	0.63
NDF, % DM	39.7	42.6	4.17	0.49
Lignin, % DM	4.5	4.8	0.39	0.57
Starch, % DM	34.4	32.6	4.89	0.73
WSC, % DM	5.2	4.4	0.65	0.25
Ash, % DM	4.4	4.8	0.37	0.33

The ivNDFD and isSD of control and down corn forage from Iowa are presented in Table 6. Numerically, the uNDF and 7 h isSD was greater for down corn. These results should be interpreted with caution as it does not appear nutrient digestibility was substantially affected by corn being knocked down in Iowa.

Table 6. The digestibility of NDF and starch for control and down corn forage in Iowa

Item	Control Corn	Down Corn	SE	*P* - Value
30 h ivNDFD, % NDF	56.8	56.2	2.86	0.84
240 h uNDF, % DM	10.7	11.5	1.88	0.69
TTNDFD, % DM	39.2	40.0	1.77	0.65
0 h isSD, % starch	22.3	23.4	3.59	0.76
7 h isSD, % starch	72.6	74	2.29	0.59

Table 7 shows the predicted energy content and beef per ton of corn forage in Iowa. There were not statistical differences in energy content, however the down corn silage was numerically lesser in energy value, accounting for small differences in fiber and starch levels and nutrient digestibilities. Based on these samples from down and damaged corn, the nutritive and energetic value of this corn appears fairly similar to normal corn silage harvested from this area. Thus, there appears to be both energetic value and potential of damaged corn for silage, but producers should also focus on the hygienic characteristics of the feed and assess both fungal and bacterial load as well as mycotoxin contamination prior to feeding.

Table 7. The predicted energy content of control and down corn forage in Iowa.

Item	Control Silage	Down Silage	SE	*P* - Value
NRC Beef Predictions				
TDN, % DM	63.8	62.2	2.66	0.57
NE_M, Mcal/kg	0.38	0.36	0.04	0.60
NE_G, Mcal/kg	0.65	0.63	0.05	0.59
Beef, kg/Mg	207	197	29	0.75

Summary

Although weather can complicate silage harvest, corn knocked down by severe weather events can still be used for silage. To harvest down corn, the harvester should be driven slowly against the direction the corn is laying. Additionally, operators should watch the header for clogs, especially if the corn is laying in different directions. Although harvesting down corn can be time consuming and more costly, it is often a better alternative to buying forage if producers do not have enough unaffected silage.

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Additionally, based on these two case studies, down corn used for silage can yield acceptable nutrient quality and warrants harvesting. However, down corn silage quality can vary depending on how severe the weather conditions were, and the field conditions between the time the corn is knocked down and harvested. Fungal, mycotoxin, and bacterial contamination should be monitored. As a result, care should be taken as described before. Down silage should be separated from normal silage, inoculated with a heterofermentative bacterial inoculant, and monitored for nutrient quality. Taking these precautions will increase the chances of making better quality down silage and help producers know what to expect when the time comes to feed the down silage.

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