Handling Drought-Affected Corn Silage

Joe Lauer, University of Wisconsin-Extension

Drought conditions persist throughout much of the corn silage areas. Conditions can change, however. In early July, NOAA's National Weather Service Climate Prediction Center showed monthly and seasonal outlooks for drought to expand. Farmers deciding about using drought-affected corn fields must first determine success of pollination. If poor pollination will affect grain yield, follow directions given by hail adjusters to ensure insurance payment. If harvesting for silage, then corn must be cut at the proper moisture; the crop is usually wetter than it appears. If pollination is unsuccessful, we are usually trying to make the best of a bad situation.

If **pollination is good,** all management options are available and corn can be harvested in a normal fashion for grain or forage use. If **pollination is poor** yet some kernels are developing, the plant can gain dry matter (DM) and farmers should wait to harvest. If the plant is not dead, these kernels may still grow, especially if fields receive rain. If kernels are growing, then DM is accumulating and forage yield and quality can improve. Many farmers have the option of harvesting poorly pollinated fields for silage use or selling to those who have livestock. If there is **no pollination**, then the best-quality forage will be found as close to flowering as possible. Quality decreases after flowering. If there is no grain, florets on the ear were either not pollinated or have not started to grow due to moisture stress, and the plant will continue to be barren. If the plant is dead, harvest should occur when whole plant moisture is appropriate for preservation and storage. The challenge is to make sure no potential pollination will occur and forage moisture is correct for the storage structure.

Drought-stressed corn can be grazed or used for forage, either as green chop or silage. Because of the potential for nitrate toxicity, grazing or green-chopping should be done only when emergency feed is needed. Green, barren stalks will contain 75-90% water. If weather remains hot and dry, moisture content drops, but if rain occurs before plants lose green color, plants can remain green until frost.

Forage quality of corn affected by pollination. Corn has two peaks in forage quality: one at pollination and one near kernel maturity. The early peak in forage quality at pollination is high for quality but too wet for ensiling. The later peak is more familiar and is the one we typically manage for when producing corn silage.

Drought-stressed corn has increased sugar content, higher crude protein, higher crude fiber, and more digestible fiber than normal corn silage. Drought generally reduces yield and grain content, resulting in increased fiber content, but this is often accompanied by lower lignin production, increasing fiber digestibility.

Coors et al. (1997) evaluated the forage quality of corn with 0, 50, and 100% pollination of the kernels on an ear during 1992 and 1993. These years were not considered "drought-stress" years, but can give us an idea as to quality changes occurring due to poor pollination. These plots were harvested in September. A typical response of corn to stress is to reduce grain yield. Bareness reduced whole-plant yield by 19% (Table 1). Kernels on ears of 50% ear fill treatments were larger and tended to more than make up for reduced numbers (Albrecht, personal communication). With the exception of protein, as ear fill increased, whole-plant forage quality increased.

Table 1. Forage yield (% of control) and quality of corn with differing amounts of pollination (n=24).

Ear fill	Forage yield	Crude protein	NDF	ADF	IVTD	NDFD
		%				
0	81	8.5	57	30	74	52
54	93	8.0	54	28	76	52
100 (control)	100	7.5	49	26	77	54
LSD (0.05)	6	0.3	1	1	1	1

Derived from Coors et al., 1997.

Forage moisture. If the decision is made to harvest the crop for ensiling, the main consideration will be proper moisture for storage and fermentation. The crop will look drier than it really is, so moisture testing will be critical. Be sure to test whole-plant moisture of chopped corn to assure yourself that acceptable fermentation will occur. Use a forced air dryer (i.e., Koster), oven, microwave, electronic forage tester, NIR, or the rapid "Grab-Test" method for your determination. With the "Grab-Test" method (as described by Hicks, Minnesota), a handful of finely cut plant material is squeezed as tightly as possible for 90 seconds. Release the grip and note the condition of the ball of plant material in the hand.

- If juice runs freely or shows between fingers, crop contains 75-85% moisture.
- If ball holds its shape and hand is moist, material contains 70-75% moisture.
- If ball expands slowly with no hand dampness, material contains 60-70% moisture.
- If the ball springs out in the opening hand, crop contains <60% moisture.

Proper harvest moisture content depends on the storage structure. It is the same for drought-stressed and normal corn. Harvesting should be done at the moisture content that ensures good preservation and storage (Table 2).

Table 2. Recommended corn moisture content (%) for various storage structures.

Horizontal bunker silos	70-65
Bag silos	70-60
Upright concrete stave silos	65-60
Upright oxygen-limiting silos	60-50

Derived from Roth et al., 1995.

Raising the bar. Depending on farm forage needs, raising the cutter-bar on the silage chopper reduces yield but increases quality. For example, raising cutting height reduced yield by 15%, but improved quality so that milk per acre of corn silage was only reduced 3-4% (Lauer, Wisconsin). In addition, the plant parts with highest nitrate concentrations remain in the field (Table 3).

Table 3. Nitrate nitrogen of corn plant parts harvested for silage.

Plant part	N03N ppm
Leaves	64
Ears	17
Upper ⅓ of stalk	153
Middle ⅓ of stalk	803
Lower ⅓ of stalk	5,524
Whole plant	978

Derived from Hicks, Minnesota.

Nitrate problems. If drought-stressed corn is ensiled at the proper moisture content and other steps are followed to provide good-quality silage, nitrate testing should not be necessary. Nitrate poisoning risk increases as pollination decreases. Nitrate problems are often related to concentration (i.e., the greater the yield the less chance of high forage-nitrate concentration). If pollination is poor, only ~50-75% of DM will be produced compared to normal corn forage. It is prudent to follow precautions regarding nitrate toxicity dangers to livestock (especially with grazing and green-chopping) and silo gasses to humans when dealing with drought-stressed corn. Soil nitrates absorbed by plant roots are normally incorporated into plant tissue as amino acids, proteins, and other nitrogenous compounds. Thus, plant nitrate concentration is usually low. The primary site for converting nitrates to these products is in growing green leaves. Under unfavorable growing conditions, especially drought, this conversion process is slowed, causing nitrate to accumulate in stalks, stems, and other conductive tissue. The highest nitrate concentration is in the lower part of the stalk or stem. If moisture conditions improve, the conversion process accelerates and within a few days plant nitrate levels return to normal. Nitrate concentration usually decreases by one-third to one-half during silage fermentation, therefore, sampling one or two weeks after filling will be more accurate than sampling during filling. If plants contain nitrates, a brown cloud may develop around the silo. This cloud contains highly toxic gases, and people and livestock should stay away. The resulting energy value of drought-stressed corn silage is usually lower than good silage but not as low as it appears based on grain content. The only way to know the actual composition of drought-stressed corn silage is to have it tested by a good analysis lab.

Estimating yield. Farmers need to carefully monitor, inspect, and dissect plants in their own fields for plant survival potential, kernel stages, and plant moisture in determining when to begin silage harvest. Fields and corn hybrids within fields vary greatly in stress condition and maturity. Often questions arise as to the value of drought-stressed corn. To estimate pre-harvest silage yields, the National Corn Handbook publication "Utilizing Drought-Damaged Corn" describes methods based on either corn grain yields or plant height (if little or no grain yield is expected). Below is a summary of these methods.

- **Grain yield method for estimating silage yield.** For moisture-stressed corn, ~1 ton silage/ac can be obtained for each 5 bu grain/ac. For example, if you expect a grain yield of 50 bu/ac, you will get ~10 tons/ac of 30% DM silage (3 tons/ac DM yield). For corn yielding >100 bu/ac, ~1 ton silage/ac can be expected for each 6-7 bu grain/ac. For example, for corn yielding 125 bu grain/ac, corn silage yields will be 18-20 tons/ac at 30% DM (5-6 tons/ac DM yield).
- **Plant height method for estimating silage yield.** If little or no grain is expected, a rough yield estimate can be made assuming 1 ton of 30% DM silage can be obtained for each foot of plant height (excluding the tassel). For example, corn at 3-4' will produce ~3-4 tons/ac of silage at 30% DM (~1 ton/ac of DM).

References & Further Reading

Coors, J. G., Albrecht, K. A., and Bures, E. J. 1997. Ear-fill effects on yield and quality of silage corn. Crop Science 37:243-247.

Roth, G., D. Undersander, M. Allen, S. Ford, J. Harrison, C. Hunt, J. Lauer, R. Muck, and S. Soderlund. 1995. Corn silage production, management, and feeding. NCR 574, American Society of Agronomy, Madison, WI:21 pp.

Utilizing Drought-Damaged Corn (NCH-58)