Nutritional Insights

MANAGEMENT OF DROUGHT STRESSED CORN SILAGE

Bill Mahanna, Ph.D., Bill Curran, Ph.D. and Bill Seglar, DVM
Pioneer Nutritional Sciences and Sales Support
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When is moisture stress most critical to the corn plant? On average corn utilizes 24 to 27 inches of water per acre during the growing season. The four-week period surrounding silking is the most important time. Repeated moisture stress during the silk to tassel stage can result in grain yield losses as high as 50 percent. Depending on hybrid maturity, it takes between 40 to 50 days to reach ½ milk line maturity from 50% silk.

TABLE 1. INFLUENCE OF MOISTURE STRESS AT VARIOUS GROWTH STAGES ON CORN GRAIN YIELD.

Stage of Development	% Yield Reduction
Early Vegetative	5 - 10%
Tassel Emergence	10 - 25%
Silk / Pollen Shed	40 - 50%
Blister Kernel	30 - 40%
Dough	20 - 30%

What is the yield potential of drought stressed corn silage? Corn silage yields may be 50 to 90% of normal under drought stressed conditions due both to shorter plant height and loss of kernel development. Timing and duration of drought stress will determine yield loss. Silk emergence is the most critical time to avoid drought stress while early vegetative is the least critical period for drought stress. When irrigation water is limited, refrain from irrigating until the silking to blister stage of development, if possible. Drought stress during the blister to dough stage can cause yield losses between 20 and 40%. Hybrids vary greatly in their ability to handle drought. Side-by-side comparisons are a good way to determine yield differences between hybrids. If little or no grain is present, a general rule is that there will be one ton of 70% moisture yield per foot of plant height.

An advantage of growing corn for silage is that less water is required to raise silage than to grow a grain crop. Generally, corn silage is harvested 15 to 20 days before black layer or physiological maturity is reached, thereby reducing the amount of water needed to mature the crop to harvest. Depending on soil type and available water, harvesting irrigated corn for silage can reduce the number of irrigations needed by one to two irrigations.

When should drought-stressed corn silage be harvested? Green, barren stalks will typically be much wetter then they appear in the field and can contain upwards of 75 to 90% moisture because there is no grain to dry down the moisture contained in the stalks. It is recommended to sample plants and conduct dry matter tests at a laboratory, or with a microwave or Koster Moisture Tester. This is important because the tendency is to harvest drought-stressed corn too early and thus too wet causing excess effluent (run-off) and the loss of nutritious sugars. Hybrid maturity, drought tolerance, and late season plant health may influence harvest timing significantly. If conditions remain hot and dry, silage harvest may occur earlier than normal. Harvest assessment will be required on a field-by-field basis. For example, level of spider mite infestation whose activity is greater under hot and dry conditions may warrant earlier harvest may be warranted. Be prepared to make harvesting adjustments with custom harvesters. If the corn has any grain, the kernel milk line can be a guideline to determine the proper time to chop but given the variability in droughty corn, plant sampling is still the best approach. In general, when the milk line is one-third to one-half of the way down the kernel, it can be chopped for bunker silo storage without incurring significant effluent losses. When the milk line is two-thirds to three-fourths of the way down to the kernel tip, whole plant moisture is 63 to 68%. Whole plant moisture is typically 50 to 60% as the black layer begins to appear at the tip of the kernel.

What effect does drought have on corn silage quality? Drought can result in plants ranging from barren plants with no ears or starch content to varying levels of starch (grain) depending upon stress at pollination and subsequent kernel abortion. Energy will be partitioned more into sugar and fiber in the stalk and leaves rather than to grain. Studies conducted by Michigan State University indicate that severely stressed corn (short plants with essentially no ears), still had a feeding value of approximately 70% of normal corn silage due to the highly digestible fiber and sugar content. Due to the potential variability, it is important to analyze droughty corn silage for dry matter, NDF (neutral detergent fiber), NDF digestibility, sugar, starch and nitrates (%NO3 or ppm NO3-N) and consider segregating storage based on fields that may have relatively higher feed value.

Are nitrates a concern? The potential for high nitrate levels occurs when crops such as corn, sorghum, and some grasses are exposed to stress situations including drought, hail, frost, cloudy weather and fertility imbalance. Immature corn that undergoes these stressors accumulate toxic nitrate concentrations in the lower portion of the stover when crop yield is less than the supplied nitrogen fertility level and due to reduced plant biochemical functions impeding nitrogen from being converted to crude protein in the kernel. If it rains, three days should be allowed before resuming harvest as plants that recover from stress will eventually convert nitrates to a non-toxic form. When high nitrate forages are fed to livestock, they induce symptomatic labored breathing from interfering with the blood's ability to carry oxygen. As a general recommendation, feeding programs should be modified if post-fermented silage contains more than 1,000 PPM of nitrate-nitrogen. It is best to feed stressed crops as silage rather than green-chop because fermentation typically reduces plant nitrate levels by approximately 30-50 percent. Drought or stressed silage should ferment a full three weeks before feeding particularly if not inoculated. Ruminants can be fed higher nitrate feeds if the rumen bacteria are given time to adapt by gradually increasing the volume of high-nitrate feed in the ration and if cattle are fed more frequently than normal. Problems also can be reduced by diluting the stressed silage with other feeds and avoiding the use of non-protein nitrogen sources, such as urea or ammonia. If the crop has been stressed or shows a marked reduction in grain content, a nitrate analysis is advised. Table 2 lists recommended nitrate-feeding tolerances for cattle.

Should the crop be chopped higher to reduce nitrate issues? It is a common recommendation to leave a higher stubble (e.g. 12”) when chopping drought-stressed corn to reduce the nitrate accumulation that occurs in the lower portions of the stalk. However, most growers are in need of forage inventory during drought conditions. Therefore, it is acceptable to chop at normal heights (4-6”) to increase forage inventories with the knowledge that the fermentation process will degrade 30-50% of the nitrates and that the silage in question will not be the sole forage. For example, in Table 2, nitrate-N levels of up to 2000 ppm are acceptable if the post-fermented feed if limited to 50% of the entire diet. This means that the pre-fermented crop could have levels upward of 3500-4000 ppm nitrate-nitrogen. When feeding ruminants non-fermented, droughty corn stalks as a major source of their diet (e.g. wintering beef cows), producers need to closely monitor nitrate levels.

TABLE 2. NITRATE LEVELS IN FORAGES FOR CATTLE.

Nitrate Ion %	Nitrate Nitrogen ppm	Recommendations
0.0-0.44	<1000	Safe to feed under all conditions
0.44-0.66	1000-1500	Safe to feed to non-pregnant animals. Limit use for pregnant animals to 50% of total ration on a DM basis.
0.66-0.88	1500-2000	Safely fed if limited to 50% of the total DM ration.
0.88-1.54	2000-3500	Feeds should be limited to 35-40% of the total DM in the ration. Feeds over 2000 PPM nitrate nitrogen should not be fed to pregnant animals.
1.54-1.76	3500-4000	Feeds limited to 25% of total DM in the ration. Do not feed to pregnant animals.
Over 1.76	>4000	Feeds containing these levels are potentially toxic. DO NOT FEED.

Adapted from Cornell University. To convert % nitrate ion (NO3) to ppm Nitrate-Nitrogen divide %N03 by 4.4 to obtain %N03-N and multiply %NO3-N x 10,000 to obtain ppm NO3-N

Is silo gas a concern with drought-stressed corn silage? Yes. Nitrates are responsible for lethal silo gas when they combine with organic silage acids to form nitrous oxide. The nitrous oxide decomposes to water and a mixture of nitrogen oxides including nitrogen oxide (colorless), nitrogen dioxide (reddish-brown color) and nitrogen tetraoxide (yellowish color). These forms of nitrogen are volatilized (smell similar to bleach) as a brownish gas in the atmosphere. This gas is heavier than air and very lethal to humans and livestock. Caution should be exercised when working around silages within 3-weeks of harvest due to the potential for these lethal nitrous oxide

For reproduction permission, contact:

Bill Seglar
Ph: 515.535.6674
E-mail: Bill.Seglar@Pioneer.com

Bill Mahanna
Ph: 515.535.6673
E-mail: Bill.Mahanna@Pioneer.com

silo gases. When tower silos were more of the norm it was a common recommendation to run the blower for at least 15 minutes before entering a recently filled silo. However, silo gas is heavier than air and can also exist around bunker, pile or bagged silages, especially near the ground with minimal air movement.

Which Pioneer ® brand inoculant is recommended for drought-stressed corn silage? Corn plants that are moisture-stressed have suppressed plant health which increases the opportunity for pathogens such as yeast and molds to more easily infect the plant. High dry matter, low compaction density silages (due to lower grain content) may further cause problems by not achieving the desired pH or anaerobic conditions which provides an environment suitable for further yeast and mold activity in the silo. The final feeding consideration for low-grain, droughty silage is the high sugar content that will exist even after fermentation is completed. The high sugar content provides substrate for the growth of spoilage organisms leading to the potential for silage heating and poor bunklife/palatability, especially in the warmer months. Here are the Pioneer corn silage inoculant recommendations, in rank order, given a drought situation (low starch corn silage) and the need to maximize the nutrient utilization of a limited silage inventory:

1) **Pioneer ® brand 11CFT**: designed to reduce pH, inhibit yeast and mold growth (*L. buchneri* strain) and improve fiber digestibility (enzyme-producing *L. buchneri* strain) in a crop typically very high in fiber and low in starch. Increases forage feeding value allowing for grain and protein savings in the diet.

2) **Pioneer ® brand 11C33:** designed to reduce pH and inhibit yeast and mold growth (contains *L. buchneri* but not the same strain as in 11CFT). Excellent choice for silage (or portion of bunker/pile/bag) being fed during warmer months.

3) **Pioneer ® brand 1174**: defensive product designed to rapidly lower pH and make modest improvements in feed value.

Inoculating silages during a drought year present a unique economic decision as a result of lowered forage and/or quality coupled with the possibility of higher local grain prices. Producers may choose to inoculate different sections of a bunker, pile or bag with different inoculants. In practice a producer might choose to inoculate the first silage that is harvested and stored in a bunker with 11CFT or 11C33, because that will be the silage being fed out next year in the warmer months. They could then choose to inoculate the remaining 40-50% of the drought-stressed crop with a more defensive product like 1174.

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E-mail: Bill.Seglar@Pioneer.com

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E-mail: Bill.Mahanna@Pioneer.com