DROUGHT STRESSED CORN FOR FORAGE

Probably to two most critical issues in dealing with drought-stressed corn for forage are: (1) Assess nitrate toxicity risk and (2) Determine and achieve proper plant moisture for silage harvest.

(1) Assess Nitrate Toxicity Risk in Drought Stressed Corn and Other Forages

Nitrate only accumulates in vegetative parts of plants, not in the grain. In corn the highest levels are found in the lowest part of the stalk. Cool season grasses such as fescue, orchard grass, and timothy are not incriminated in nitrate poisoning, and legumes are seldom a problem. Green chop made from drought stressed crops such as corn grown on highly fertile soils is the most dangerous. The following is an excellent article that provides details in nitrates in forages, how to test for them, and how to interpret laboratory test results. [http://www.iowabeefcenter.org/Forages_nitrate_toxicity.htm](http://www.iowabeefcenter.org/Forages_nitrate_toxicity.htm) The article does not provide a list of testing labs, however, any of the usual soil testing labs are also equipped to test for nitrates in plants. You can find you own lab on line or work with your fertilizer dealer or livestock nutritionist. Here is a listing of some testing labs off of the Iowa Department of Agriculture web page: [http://www.iowaagriculture.gov/feedAndFertilizer/certifiedSoilTesting.asp](http://www.iowaagriculture.gov/feedAndFertilizer/certifiedSoilTesting.asp) I find it the quickest to just phone the lab and ask specifically about how to send them a plant sample for a nitrate test. Navigating some of the web sites can be a challenge.

(2) Determine Plant moisture for Silage Harvest

Don’t be fooled by how dry the drought damaged corn looks. Most of the corn is still probably over 75% moisture. Too wet to just ensile.

To determine actual whole plant moisture:
1) Sample some representative plants from the field.
2) Chop the plants, maybe run them through a chipper-shredder or other devise.
3) Test for moisture using the Koster moisture tested (everyone that harvest silage should have one of these), or other method such as a microwave oven or heat lamp. The microwave oven or heat lamp method is describe in: [http://www.extension.iastate.edu/Publications/RECOVERY14.pdf](http://www.extension.iastate.edu/Publications/RECOVERY14.pdf)
4) If the moisture is over 70%, the problem then becomes how to harvest and properly ensile this forage. The answer is easy, but to accomplish this is difficult. The answer is to add dry matter to reduce moisture content. Air dry alfalfa or grass forage will decrease the moisture content of wet forage approximately 5 percentage units for each 150 to 200 pounds of material added per ton of wet forage weight. Some other possible options may include: (1) Altering the rate, amount and kind of acid production, (2) Acidifying the silage, (3) Inhibit bacteria and mold growth, (4) "Culturing" silage (inoculants). These are all briefly discussed in the following publication:  http://www.ag.ndsu.edu/pubs/ansci/dairy/as1254w.htm

ONE MORE ITEM… The following is a just released article from ISU Extension encompassing a number of factors in dealing with drought stressed corn for forage. It includes some things mentioned above, but provides additional information on these issues.

Drought-damaged Corn and Soybeans – When they are not going to make a grain crop, is there a forage alternative?
Stephen Barnhart, ISU Extension Forage Agronomist, Roger, Elmore, ISU Extension Corn Agronomist, and Andy Lenssen, ISU Soybean Systems Agronomist

As people reflect on the reasons for the irregular development and poor grain production in Iowa this year, the next important questions relate to evaluation of crops in individual fields and planning when and how to harvest them to the greatest economic advantage. This evaluation involves reviewing normal crop growth and development, assessing the condition of the crops in individual fields relative to normal and to think through several harvest scenarios such as: will this field have a harvestable grain crop, are there concerns about the crops, and what use or management alternatives do I have?

Corn
Most of the Iowa corn crop is intended for harvest as dry grain. If it has sufficient grain content and quality, corn will be more valuable as harvested grain. If the field or parts of the field fall short of economic grain potential, some producers can harvest this low-yield corn for silage or use it in grazing programs.

Predicting grain yield mid-season is difficult. It involves assessing what you have in the field and comparing that with normal crop growth and development. With normal corn development, the number of pollinated kernels should be visible at about 10 to 12 days after silking (blister stage). This represents potential grain set. If weather conditions have adversely affected pollination, it will be evident at blister stage. For the remainder of the summer, weather conditions influence how many of these pollinated kernels develop, and the stage of their development. Harvest decisions can then be based on knowledge of seed development gained by monitoring.

If the crop does not appear to be developing well, and you are making early forage harvest decisions, the following guidelines have been adapted from the Univ. of Wisconsin Extension for estimating silage yield of moisture-stressed corn.

**Grain yield method for estimating silage yield**
For moisture-stressed corn, about 1 ton of silage per acre can be obtained for each 5 bushels of grain per acre. For example, if you expect a grain yield of 50 bushels per acre, you will get about 10 tons/acre of 70% moisture silage (3 tons/acre dry matter yield). For corn yielding more than 100 bushels per acre, about 1 ton of silage per acre can be expected for each 6 to 7 bushels of grain per acre. For example, corn yielding 125 bushels of grain per acre, corn silage yields will be 18 to 20 tons per acre at 70% moisture (5 to 6 tons per acre dry matter yield).

**Plant height method for estimating silage yield**

If little or no grain is expected, a rough estimate of yield can be made assuming that 1 ton of 70% moisture silage can be obtained for each foot of plant height (excluding the tassel). For example, corn at 3 to 4 foot corn will produce about 3 to 4 tons per acre of silage at 70% moisture (about 1 ton per acre of dry matter).

In addition to yield, other factors also should be considered. Stage of development or condition of growth also has an influence on the feed value of the harvested crop. Compared to normal corn, corn that would yield about 20 to 40 bu/A would have about the same pound for pound feed value. Very poorly pollinated stalks with 0 to 20 bu/A yield potential would have about 80 to 90 percent the feeding value of normal corn. Short, barren stalks would have only about 70 to 80 percent the feed value of normal corn.

In what form will the corn be harvested and used? The three most practical options for using drought-damaged corn are green chopping, ensiling, and storing as dry stover. Each system has some advantages and disadvantages. Producers should consider the fungicides, herbicides or insecticides used in their corn production. Each of these products has a legal preharvest interval. Early harvest of grazing may violate these intervals. Growers should carefully check the label for any restrictions that may affect harvest or harvest timing.

**Green chopping corn** provides an immediate source of feed for dry lot, or supplement on pasture. A disadvantage may be a potentially high level of nitrates in the drought-damaged, fresh forage. Producers are encouraged to have fresh chopped corn tested for nitrates at a nearby commercial feed testing laboratory if there is any concern about high levels.

**Chopping corn for silage** provides a less immediate feed source, but a form that can be stored and fed over a longer period of time. One of the main management challenges of harvesting drought-damaged corn for silage is cutting the plant at the proper moisture content for the type of silo structure in which the forage will be stored. Corn should be stored at 65 – 70 percent moisture in a bunker or trench silo and at 60 – 65 percent moisture in upright silos. In plants with at least some grain, the dry down rate of the grain will provide a rough guide for predicting whole plant moisture.

Plants with no grain but with some live green leaf tissue still evident will have surprisingly high moisture content (75 – 80 percent); too high for direct cut ensiling. In some cases even when all the visible leaves have turned brown, the whole plant moisture is still above 70 percent moisture. Plants that have actually died will lose moisture very quickly and could drop below 50 percent moisture in a short time, too low for best nutrient conservation as silage.
An accurate moisture test from a representative field sample is an important piece of information needed to manage a corn crop for silage. It is difficult to estimate the whole-plant moisture content in the field. The best method may be to chop a representative area of the field with the silage chopper to be used and send the representative sample of chopped forage to a test lab for moisture determination. Moisture determinations can be made at a nearby feed testing laboratory or with a home check using an accurate scale and a microwave oven or heat lamp to dry the sample. Use caution when drying forage in a microwave oven or under a lamp at home. As the plant material dries it becomes more combustible! Special precautions should also be taken to avoid permanent damage to microwave ovens.

If nitrate concentrations are a concern in the chopped crop, ensiling can diminish the nitrate concentration by 30 to 50%. Good management would be to have the silage tested by a commercial feed testing laboratory, after ensiling, to estimate nitrate concentration and nutritive value for livestock.

Harvesting drought-injured corn as silage will not be a good option for everyone. Making good silage from a normal corn crop requires some degree of skill and attention to detail. If you do not already have the harvest machinery, a silage storage structure in good condition, experience in making corn silage, and a well-defined plan for silage use, then making silage from drought-damaged corn may be a high risk venture.

Too often producers who are looking for a 'cheap way' to salvage a crop as silage choose to store silage in a wide, low pile on the ground, possibly even bounded on each side by a row of large round hay bales. These piles may seem to be low cost initially but spoilage and waste is often high and as a result the 'cost' per ton of usable, good quality silage is higher than expected.

Stacking or baling as dry corn stover. Drought-damaged corn has dried quickly in many areas. Corn that has dried below 55-60 percent moisture is not a good material for ensiling. Rather, it should be considered for possible stacking or baling as dry corn stover. Timeliness is not quite as critical when harvesting stover. It should be dried to 20 percent moisture or less to avoid spoilage in storage and should be harvested before excessive leaf loss occurs. High nitrates can be a concern with stover. If you're concerned, have a nitrate test done on a representative sample. A few other suggestions are to store stover at a dry location near the site of feeding, and provide limited access to stover during feeding to stretch feed supplies and minimize feeding waste while allowing livestock to adapt to potentially high nitrate-concentration forage.

**Soybeans**

Soybeans are primarily grown for oil and protein in the Midwest. However, soybeans were first introduced to the U.S. as a forage crop, and still have that potential. In a season such as this, when poor establishment and drought stress may have limited the potential as a bean crop, when is it appropriate to abandon hope of profitable grain yield from a soybean crop and look to it as a possible forage source? The critical decision should be based on whether it will produce an economic bean yield.
Iowa research shows that 100,000 to 125,000 soybean plants per acre at harvest typically produces 95% or more of maximum yield. At lower plant populations, soybean plants compensate with increased branching, producing more pods per plant. Bean yields remain relatively constant until populations drop below about 64,000 plants per acre at harvest. Bean yield estimate methods have been developed for stands about three weeks prior to combine harvest, so their usefulness is of limited value when drought stressed soybeans are being assessed in mid-summer for harvest as beans or as forage.

**Soybeans as a Forage Crop?**
If the decision is made to abandon a bean crop and instead harvest the soybeans as forage, the decision should be made before the soybean plants reach developmental stage R6 (full green bean stage). Soybean forage may be more valuable in a dry growing season when traditional hay production is limited.

**What is the forage quality of soybean forage?**
When in vegetative and early grain development stages, the soybean plant is very similar in feeding value and harvestable yield to that of more familiar forage legumes such as alfalfa or red clover. As with other forage plants, the developing stem becomes less digestible while the leaves, and in the case of the soybean, the pods and developing seed remain highly digestible. Data presented in Table 1 shows relative yields and nutritive characteristics of whole plant soybean forage at increasing stages of development. Note that while the protein and digestibility remain surprisingly constant over this range of harvest periods, the harvestable dry matter increases with maturity. Beyond R6, however, the leaf material will quickly be lost, leaving a forage material with a high proportion of high quality pods with beans and the remainder being very low quality, high fiber stems. The risk of pod and bean shatter loss also increases if soybeans are harvested much past R6.

The feed value of soybean stems alone is lower than that of corn stover. However, the feed value of soybean hay containing leaves and mature pods is greater.

**Table 1. Yield and quality of soybean forage as affected by harvest maturity.** (University of Wisconsin).

<table>
<thead>
<tr>
<th>Maturity Stage</th>
<th>Dry Matter Yield (T/ac)</th>
<th>Moisture %</th>
<th>% Crude Protein</th>
<th>Relative Feed Value Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>1.1</td>
<td>81.1</td>
<td>20.1</td>
<td>160</td>
</tr>
<tr>
<td>R3</td>
<td>1.7</td>
<td>80.7</td>
<td>18.1</td>
<td>138</td>
</tr>
<tr>
<td>R5</td>
<td>2.5</td>
<td>79.7</td>
<td>18.2</td>
<td>128</td>
</tr>
</tbody>
</table>

1. R1 - Any open flower at any leaf attachment point (node) on the main stem.
   R3 - At least one pod is 3/16 inches long at one of the four uppermost leaf attachment points (nodes) on the main stem with a fully developed leaf.
   R5 - Seed is 1/8 inches long in at least one pod at one of the four uppermost leaf attachment points (nodes) on the main stem with a fully developed leaf.

2. Relative Feed Value (RFV) index. An RFV of 150 approximates the feeding value of mid-bud alfalfa. An RFV of 100 approximates the feeding value of nearly full bloom alfalfa.
Managing soybeans for dry hay?
Immature soybeans will have some of the same field curing challenges as other forage legumes, primarily due to stems drying more slowly than leaves. Soybean leaves become brittle when dry and can shatter excessively during raking and baling. While the use of a mechanical conditioner will speed the drying of stems, producers have found that flail conditioners lead to more leaf and pod losses than roller-type conditioners. If windrows are raked, it should be done when relative humidity levels are higher and leaves have absorbed some moisture, conditions that occur during early morning, late evening, or nighttime hours. Soybean hay bales are subject to more rain and weathering loss if stored outside than are those of grass or alfalfa hay, so inside or covered storage is recommended.

Managing soybeans for silage?
Producing good soybean silage requires techniques more similar to those used for silage produced from alfalfa than for silage produced from corn. Better feed value retention from soybean dry matter will occur if soybeans can be stored as silage than hay. The target range for moisture content when ensiling soybean is 60 to 65%, so green plants cut for silage may require some field wilting before chopping. Drying conditions will dictate how long the wilt period should be. If wilted too long, the silage will be more difficult to pack, and you increase the risk increased dry matter loss from excessive respiration and heating during ensiling. Excessively dry haylage may represent a fire hazard.

Soybeans chopped and stored at higher than 70% moisture may undergo abnormal or incomplete fermentation and will begin to lose dry matter as seepage (effluent) losses. Use caution when locating a site for silage storage with potential for seepage losses because off-site movement of silage effluent can become an environmental hazard as a ground or surface water contamination source. High-moisture forage legumes, likely soybeans too, usually have lower concentrations of soluble carbohydrates than does chopped corn. Adequate concentrations of soluble carbohydrates are necessary for rapid pH decrease during the ensiling process.

It is difficult to estimate the moisture content of immature, standing soybeans. Sample several representative plants from the field and have moisture determinations made at a nearby feed testing laboratory. Or, alternatively check plant moisture with a home check using an accurate scale and a microwave oven or heat lamp to dry the sample. Use caution when drying forage at home with a microwave oven or heat lamp. As the plant material dries it becomes more combustible! Special precautions should also be taken to avoid permanent damage to microwave ovens.

A few additional cautions about using soybeans for forage.
Review your fungicide and herbicide labels for any restrictions regarding preharvest intervals. Soybean forage being stored as silage often will ferment more favorably and attain a lower pH if inoculated with a lactic acid bacteria inoculant applied at the chopper or at the silo. Several animal nutritionists say that very immature, green soybeans with only small pods and no appreciable bean formation can be fed as you would feed other legume forage. However, as the whole plant fat content increases with bean development, these nutritionists caution producers to
limit the amounts fed daily to livestock. Check with a nutritionist when formulating rations containing soybean forage.

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