# *2010 Drought Handbook for Animal/Forage Producers*

Adapted to Maryland by:
University of Maryland Extension Agriculture Profitability Team

The original concept and design for this handbook came from:
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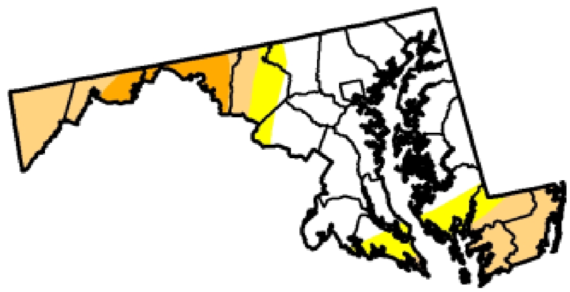
# U.S. Drought Monitor
## Maryland

**August 31, 2010**
Valid 7 a.m. EST

*Drought Conditions (Percent Area)*

| | None | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4 |
|---|---|---|---|---|---|---|
| Current | 58.1 | 41.9 | 30.2 | 6.1 | 0.0 | 0.0 |
| Last Week (08/24/2010 map) | 58.1 | 41.9 | 22.5 | 3.7 | 0.0 | 0.0 |
| 3 Months Ago (06/08/2010 map) | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Start of Calendar Year (01/05/2010 map) | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Start of Water Year (10/06/2009 map) | 81.2 | 18.8 | 11.8 | 0.0 | 0.0 | 0.0 |
| One Year Ago (09/01/2009 map) | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |



*Intensity:*

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements*

**http://drought.unl.edu/dm**

***Released Thursday, September 2, 2010***
***Author: Brad Rippey, U.S. Department of Agriculture***

# Foreword

This handbook was originally compiled by Craig Yohn, West Virginia University Extension Agent-Jefferson County in response to the widespread drought of 2007. The handbook was adapted to Maryland conditions in 2007 by Ben Beale, Extension Educator with University of Maryland and distributed to farmers during that time. We had hoped it would stay on the shelves and collect dust for a while longer. Unfortunately that is not the case.

The summer of 2010 has been a challenge for most producers around the state. The spring started off without a hitch. Crops were planted on time and looked very good heading into the summer growing season. However June and July brought record heat coupled with sporadic rainfall. The result has been a very poor growing season. We anticipate a marked decline in yields of many crops, particularly hay, pasture and corn.

Thus, the University of Maryland Agriculture Profitability team, in conjunction with industry and government partners, revised the drought handbook for use in 2010. The handbook has been expanded to include a grain edition and forage/animal edition. The handbook contains a wide variety of information relevant to drought conditions.

A major difference between 2007 and 2010 is the relief from more rains and cooler temperatures in August. Thankfully, many soybean acres will have a chance to rebound. It may also open up some options for emergency forage seedings and allow for decent germination of cover crop and small grain plantings.

The UME Ag Profitability Team appreciates the efforts of Kathi Dionne, Administrative Assistant in the St. Mary’s County UME office for assistance in layout and editing.

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# *Feed Related Information*

# Maryland Department of Agriculture Offering Free Grain/Forage Testing Program

The Maryland Department of Agriculture (MDA) is offering a free testing program to drought impacted Maryland farmers for nitrate and prussic acid in forage and for aflatoxin in corn grain. Prussic acid poisoning is mostly associated with sorghum and related species. The program is a cooperative effort between MDA and the University of Maryland Extension. Testing is done by the MDA State Chemist's Section.

Farmers can bring their samples to their nearest UME office so that UME can assist them with paperwork and make sure the samples and paperwork are properly prepared. MDA will pick up the samples daily (Monday through Friday) and fax results to farmers usually within 24 hours.

Instructions for preparing and packing samples for testing are below. Use one Sample Identification and Information Sheet for each sample submitted. Place samples in a plastic bag and refrigerate or freeze as soon as possible, especially if held overnight, and keep on ice during transport. Each separate field should have its own paperwork and sample.

**Taking corn samples for aflatoxin analysis:**

- Collect 12 ears of corn from different areas of the field to get a representative sample.
- Keep cold as described above.

(Note: Shelled corn already harvested can also be tested. Collect a 1 quart representative sample and bring to the Extension office)

**Taking silage samples for nitrate and prussic acid analysis:**

- Collect at least 10 stalks from different areas of the field to get a representative sample.
- Chop silage up into 6" pieces and thoroughly mix samples together.
- Prussic acid samples must be kept frozen at all times to prevent volatilization of prussic acid (hydrocyanic acid).

# Managing Drought-Stressed Corn for Silage

**Charles R. Staples**[1]
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## Harvesting Guidelines

Occasionally a year's corn crop falls substantially short of the harvest we've become accustomed to. Still, valuable nutrients remain to be salvaged for feeding purposes. While yields may be reduced, the plants can still be harvested and utilized with some additional attention. In a normal year about one week after pollination has occurred, small white blisters will start to form on the cob. These early kernels will continue to develop to maturity if water is available. Delay the harvest if most of the stalks have ears, even if the leaves are turning brown. The extra water in stalks and leaves will allow the kernels to continue to increase in weight. If the stalks have only a few ears, don't delay the harvest once the leaves die and start to drop off.

## Toxicity Danger

### Animals

Some growers may be tempted to graze or greenchop the corn. This is not recommended because the risk of nitrate-nitrite toxicity is too great. Nitrates accumulate in the plant only if there is a large amount of nitrate in the soil (caused by fertilizing with nitrates) and something interferes with normal plant growth (drought). A good shower on droughted plants will cause the plant to take up soil nitrates quickly.

If it is harvested and fed to animals soon afterward, toxicity can occur. Ruminants consuming nitrates reduce them to nitrites which are absorbed and can cause toxicosis. Moderate levels of nitrite can be tolerated, but high concentrations overwhelm the animals' system, causing a decreased ability of the blood to carry oxygen.

Symptoms of nitrite toxicity include increased pulse rate, quickened respiration, heavy breathing, muscle trembling, weakness, staggered gait, blindness, and even death. If the blood is sampled, it will be a chocolate brown color rather than bright red.

If drought-stricken corn plants are to be used as feed, have them analyzed for nitrates. Laboratory analyses may be reported in several ways. Equation 1 shows how you can calculate nitrate nitrogen:

$$\text{Nitrate } (NO3) \times .23 = \text{nitrate nitrogen}$$
$$\text{Potassium nitrate } (KNO3) \times .14 = \text{nitrate nitrogen}$$
$$\text{Sodium nitrate} (NaNO3) \times .16 = \text{nitrate nitrogen}$$

Equation 1.

Feeding guidelines for feedstuffs containing different concentrations of nitrates are in Table 1 . High energy feeds such as grains are best to feed in conjunction with high nitrate silages.

An excellent way to reduce the nitrate level in plants is to ensile them. One-fifth to two-thirds of the nitrate may be eliminated during the ensiling process. Wait three weeks after ensiling before feeding the silage so that the fermentation process can be completed. The amount of moisture in the plant will affect the length of fermentation. Corn ensiled at less than 55% moisture will undergo less fermentation and less nitrates will be converted. Dry corn doesn't pack well. Air is trapped, which causes heating and molding to occur, instead of proper fermentation. Adding water at ensiling may improve the fermentation process.

An additional way to reduce the nitrate levels is to harvest the corn a little higher from the ground than normal as the lower third of the stalk contains the highest concentration of nitrates. See Table 2 .

**Humans**

While nitrate-nitrogen may harm livestock at 4,000 parts per million (ppm), nitrogen dioxide levels as low as 25 ppm can be toxic to humans. Nitrogen dioxide comes from nitrate-nitrogen during fermentation. Most gases are produced 3-4 days after filling the silo, but the production of gases begins within 2 hours. Concentrations of 25 ppm are invisible and can't be smelled. When concentrations of nitrogen tetroxide reach 100 ppm, the gas appears yellowish brown and smells like laundry bleach. It will leave a yellow stain on most material it contacts. If inhaled, nitric acid forms in the lungs where it can quickly corrode the tissues. Do not enter a tower silo without first running the blower for at least 10-15 minutes. Follow this procedure for at least the first 2-3 weeks alter filling.

**Feeding**

Silage made from corn having no ears or partially filled ears have 65~80% the value of normal corn silage on a dry matter basis. Typical nutrient compositions of various weather-damaged corn silage is in Table 3 . As drought damage intensifies, energy content decreases and protein content increases. Be sure to test your corn for its chemical content in order to take advantage of its higher crude protein content.

Avoid feeding urea or urea-containing feeds with drought-stressed corn. Much of the nitrogen in the leaves and stalks is very soluble, similar to urea. This soluble nitrogen is converted to ammonia quickly in the rumen and can be excreted in the urine without providing any benefit to the animal.

Supplementing drought-stressed corn with plant or animal protein such as peanut or soybean meal will often result in better animal performance. Table 4 compares the feeding value of normal and droughted corn supplemented with either urea or soybean meal for steer gains.

Steers receiving normal corn silage performed similarly to those receiving drought-stressed corn silage. Urea was effective in improving daily gain when fed with normal corn silage but was ineffective when fed with droughted corn silage. Soybean meal supplementation was most beneficial.

**Summary**

1. Drought-stressed corn can usually be salvaged as a usable feed although nitrate toxicity can pose a serious problem for animals.
2. Ensiling the plants will usually reduce the amount of nitrate-nitrogen by one-fifth to two-thirds.
3. Properly sample and test the plants for nitrate-nitrogen. Adjust the ration to keep nitrate levels below 0.4% of ration dry matter.
4. Nutritive value of drought-stressed corn will generally be 65-85% of normal corn. Feed plant or animal protein sources with droughted corn rather than urea for optimum animal performance.

**Tables**
Table 1.

| **Table 1**. Nitrate nitrogen levels and corresponding feeding guides | | |
|---|---|---|
| Percent* | Parts per million | Feeding guide |
| 0.0 to 0.3 | 3000 | Gradually introduce feed |
| 0.3 to 0.5 | 3000 to 5000 | Limit silage to à of total ration dry matter |
| over 0.5 | 5000 | Limit silage to 1/4 of total ration dry matter |
| * Dry matter basis | | |

Table 2.

| **Table 2**. Nitrate in drought-affected corn | |
|---|---|
| Plant part | ppm of $No_3$-N |
| Leaves | 64 |
| Ears | 17 |
| Top 1/3 stalk | 153 |
| Mid 1/3 stalk | 803 |
| Lower 1/3 stalk | 5524 |
| Weighted average | 978 |
| Source: Walsh and Schulte. 1970. Soils Dept., Univ. of Wisconsin | |

Table 3.

| **Table 3.** Nutrient composition of various corn silages. | | | | |
|---|---|---|---|---|
| | DM1 | CP2 | ADF3 | TDN4 |
| Type of silage | (%) | .............................. % dm basis ............................. | | |
| Normal, dent stage | 35 | 8.5 | 28 | 68 |
| Drought-stressed, few ears | 30 | 9.9 | 36 | 60 |
| Drought-stressed, no ears | 22 | 11.0 | 40 | 56 |
| [1] Dry matter | [2] Crude protein | [3] Acid detergent fiber | [4] Total digestible nutrients | |

Table 4.

| **Table 4.** A comparison of normal and drought-stressed corn silage rations for growing steers. | | | |
|---|---|---|---|
| Forage | Nitrogen Supplementation | **Daily Gain(Ib. per day)** | Ib. Of Feed per Ib. of Gain |
| **Corn silage** | None | 1.03 | 11.9 |
| | Urea | 1.64 | 8.3 |
| | Soybean meal | 1.81 | 7.7 |
| **Drought-damaged** | None | 1.08 | 12.4 |
| **Corn silage** | Urea | 1.18 | 11.9 |
| | Soybean meal | 1.47 | 9.8 |
| Source: Krause et. al. 1976. Nebraska Beef Cattle Report. | | | |

Footnotes

1. This document is DS22, one of a series of the Animal Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date November 1988. Reviewed June 2003. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.

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U.S. Department of Agriculture, Cooperative Extension Service, University of Florida, IFAS, Florida A. & M. University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Larry Arrington, Dean.

MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK–EASTERN SHORE

Fact Sheet

Fact Sheet 426

## Causes and Prevention

# Nitrate Poisoning of Livestock

Periodically there are concerns about possible toxicity to livestock from high levels of nitrates in forages. Nitrate poisoning is generally caused by animals eating too much forage that is high in nitrates, which have not been changed to protein in the plant. It can also be caused by animals eating too much urea or nitrogen fertilizer that has been spilled in the field or left where animals can find and eat it. Nitrate fertilizer is quite palatable, especially to cattle.

## Causes of High Nitrates in Forage

All plants contain some nitrate, but excessively high levels are likely to occur in forages having been grown under stress conditions, such as when corn fertilized for high grain yield is stunted by drought and is alternatively harvested for silage. Other plants, such as sudangrass, sorghum, pearl-millet, oats, orchardgrass and tall fescue, can also accumulate nitrates at high levels. Most weeds commonly found in corn also accumulate toxic levels of nitrate, including red root pigweed, common lambsquarters, ragweed, velvetleaf, witchgrass, Canada thistle, and black nightshade.

Nitrates accumulate in plants only when: 1) there is a large amount of nitrate in the soil, or 2) some factor interferes with normal plant growth. High rates of nitrogen fertilization and drought conditions are the most important factors contributing to nitrate buildup in plants. Generally there is a direct response in plant nitrate concentration to increasing fertilizer nitrogen. Nitrate accumulation is greater from nitrate fertilizers than from ammonium sulfate or urea. Nitrate accumulation also is greater with delayed applications of fertilizer.

The highest levels of nitrate accumulate when drought occurs during a period of heavy nitrate uptake by the plant. A drought during or immediately after pollination is often associated with the highest accumulation of nitrates. Extended drought prior to pollination is not necessarily a prelude to high accumulations of nitrate. The resumption of *normal* plant growth from a heavy rainfall will reduce nitrate accumulation in corn plants, and harvest should be delayed for 3 to 4 days after the rainfall.

Nitrates absorbed from the soil by plant roots are normally incorporated into plant tissue as amino acids, proteins, and other nitrogenous compounds. Thus, the concentration of nitrate in the plant 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 retarded, causing the nitrate to accumulate in the stalks, stems, and other conductive tissue. The highest concentration of nitrate is in the lower part of the stalk or stem. For example, the bulk of the nitrate in drought-stricken corn plants can be found in the bottom third of the stalk (Table 1). If moisture conditions improve, the conversion process accelerates and within a few days nitrate levels in the plant return to normal.

Not all drought conditions cause high nitrate levels in plants. If the supply of soil nitrates is in the dry soil surface, plant roots will not absorb nitrates. Some soil moisture is necessary for absorption and accumulation of the nitrates.

## Nitrate Toxicity in the Animal

Like plants, ruminant animals also use the nitrogen in nitrates to make protein. Conversion is made by bacteria in the rumen. Nitrite, one of the intermediate products in this conversion, is the cause of nitrate poisoning. Nitrate toxicity occurs when high nitrate levels in the feed overwhelm the animal's digestive system to the extent that the rate of conversion of nitrate to nitrite is faster than the conversion of nitrite to ammonia (which is incorporated into amino acids and protein). When this happens, nitrite accumulates and is absorbed into the bloodstream. There, it reacts with the oxygen-carrying hemoglobin, changing it into a form (methemoglobin) that cannot trans-

**Table 1. Nitrate nitrogen in 28 samples of drought-stressed corn.**

| Plant Part | ppm $NO_3N$[1] |
|---|---|
| Leaves | 64 |
| Ears | 17 |
| Upper 1/3 stalk | 153 |
| Middle 1/3 stalk | 803 |
| Lower 1/3 stalk | 5,524 |
| Whole plant | 978 |

[1]ppm=parts per million

Source: University of Wisconsin

port oxygen to the lungs and body tissues and the animal literally suffocates. Cattle are much more likely to be affected than are sheep or horses.

The toxicity level depends both on how much and how fast nitrate was consumed. For example, it takes about twice as much nitrate to kill a ruminant when nitrate is eaten in forage as when it is consumed quickly as in a supplement or accidental consumption of nitrate fertilizer. In the case of forage, toxicity generally occurs when cattle consume large amounts of forage containing 1.76 percent or more nitrate ion on a dry matter basis. Even forage with lower levels of nitrate may adversely affect reproduction or become toxic if animals are nutritionally stressed or ill and they suddenly consume large quantities of such forage.

The recommended uses for forages containing various levels of nitrate are listed in Table 2.

A high level of nitrate or nitrite in drinking water may make it necessary to further reduce intake of nitrate-containing forage. A total intake of 30 to 45 grams of nitrate ion per 100 pounds of bodyweight is considered acutely toxic in normal animals. However, intakes of 8 to 22 grams per 100 pounds of bodyweight may be toxic when animals are ill or undergoing an abrupt diet change.

Symptoms of nitrate poisoning appear suddenly. Dyspnea (difficult breathing) becomes progressively more severe until signs of marked respiratory distress, including mouth breathing, violent respiratory movements and extreme apprehension, are observed. A rapid weak heart beat, below normal body temperature, muscular weakness, loss of muscular coordination (staggering gait and muscular tremors), blue coloration of mucous membranes, and marked dilation of pupils follow initial observed symptoms. Brownish discoloration of the blood is characteristic of nitrate poisoning. Death may occur within 1 hour or, in the usual case, within 3 to 4 hours of the onset of difficult breathing.

Subacute or chronic nitrate poisoning may result in reproductive problems, including abortions. Abortions due to nitrate should be accompanied or preceded by some evidence of nitrate poisoning in the animals, including bluish discoloration of unpigmented areas of the skin or mucous membranes. Poisoning symptoms that precede abortions may be missed if animals are not being closely observed, since the abortions will occur several days after the animal consumes the nitrate.

**Table 2. Guide for nitrate levels in forages for mature cattle.**

| Percentage nitrate ion ($NO_3^-$) (dry matter basis) | Content of nitrate nitrogen (dry matter basis) | | |
|---|---|---|---|
| | percentage | ppm[2] | Comments[1] |
| less than 0.44 | 0.0 - 0.10 | 0 - 1,000 | Safe to feed if adequate feed and water are available. |
| 0.44 - 0.66 | 0.1 - 0.15 | 1,000 - 1,500 | Safe for nonpregnant animals. Limit to 50 percent of total ration dry matter for pregnant animals; animals may go off feed, have a slow drop in production, some abortions possible. |
| 0.66 - 0.88 | 0.15 - 0.20 | 1,500 - 2,000 | Limit to 50 percent of total ration dry matter for all animals; may experience some symptoms, possibly death. |
| 0.88 - 1.54 | 0.20 - 0.35 | 2,000 - 3,500 | Limit to 35 to 40 percent total ration dry matter. **Do not feed to pregnant animals.** |
| 1.54 -1 .76 | 0.35 - 0.40 | 3,500 - 4,000 | Limit to 25 percent total ration dry matter. **Do not feed to pregnant animals.** |
| greater than 1.76 | greater than 0.40 | greater than 4,000 | **Toxic—do not feed.** |

[1] Total ration dry matter refers to total dry matter being consumed as forages and concentrates.

[2] ppm = parts per million

Milk production and appetite generally are not affected by subacute nitrate intake. Reproductive problems may be prevented if nitrate-containing feeds are gradually introduced into the diet and the nitrate level in the total ration dry matter is maintained below 1.76 percent.

**Treatment:** If you suspect nitrate poisoning, call your veterinarian immediately. Since death comes from oxygen deficiency, cattle should be handled as little and quietly as possible to minimize oxygen usage. Administration of a 2 percent solution of methylene blue, by your veterinarian, aids in the reconversion of methemoglobin to hemoglobin, increasing the oxygen carrying capacity of the blood and reversing the poisoning process. This treatment may need to be repeated since absorption of nitrate will continue from a full rumen. Mineral oil or mucilaginous substances may be given orally to protect irritated mucous membranes, help reduce the absorption of nitrates and aid in their elimination.

## Reducing the Threat of Nitrate Toxicity

Under normal feeding situations the nitrate levels in feed must be well over 1.76 percent to cause a problem. Very few forages, particularly corn, contain levels that will produce toxicity. If, however, growing conditions do favor the accumulation of nitrate in forage, the following management practices will greatly reduce the chances of problems occurring:

1. Consider ensiling the forage; this will reduce nitrate levels. Studies at Purdue University showed that ensiling corn forage reduced nitrate concentration by about one-third (Table 3). Feeding should be delayed until the fermentation process is complete. This usually takes about 4 weeks. Purdue University studies have also shown that adding 20 pounds of limestone per ton of silage going into the silo further reduced nitrate levels. Adding more than 20 pounds per ton adversely affected fermentation and quality of the silage. Limestone tends to raise the pH which, in turn, can reduce silage quality.

Nitrate levels in silage also can be reduced by chopping the top two-thirds of the plant since nitrate accumulation is highest in the bottom third of the stalk or stem. Leaving that much of the plant in the field is often a difficult decision but it may be less costly than the possible loss of animals. Stalks left in the field can be a source of nitrogen for next year's crop.

Ensile at the proper moisture content (60 to 68 percent), chop clean and pack well. Proper ensiling procedures improve the fermentation process and help to reduce nitrate levels.

Application of anhydrous ammonia to drought-stricken corn is not recommended. The additional nitrogen has the potential to impede the breakdown of nitrates in the rumen, particularly if energy is limited in the ration.

2. Before starting to feed the forage, have it chemically analyzed for nitrate content. In fact, a complete feed analysis is advisable because drought-stressed forages tend to have higher protein content and reduced levels of total digestible nutrients (TDN) or energy. Forage test kits, for several private commercial laboratories, including sampling and mailing instructions, are available. For a list of soil testing labs, check with your county agent or go to the web at http://www.agnr.umd.edu/soiltesting.

3. Dilute known high nitrate feeds with low nitrate feeds, such as grain or legume hay, to reduce the percentage of nitrate in the daily ration. Grain feeding seems to be helpful in addition to its effects in diluting the nitrate content of the feed. Energy from the grain helps to complete the conversion of nitrate to ammonia, which is then used by the rumen bacteria to make bacterial protein. Corn forage is normally a high-energy feed that favors the use of nitrate in the rumen. Sudangrass, on the other hand, is a low-energy feed which, by itself, does not promote the conversion of nitrate to ammonia.

**Table 3. Effect of ensiling on nitrate concentration in corn silage.**

| | Nitrogen applied (lb/acre) | | |
|---|---|---|---|
| Corn fed as | 0 | 200 | 800 |
| Green forage<br>Nitrate (ppm[1]) | 602 | 2,319 | 4,438 |
| Silage<br>Nitrate (ppm) | 380 | 1,468 | 2,861 |
| Decrease with ensiling (percentage) | 37 | 41 | 36 |
| pH | 3.9 | 3.8 | 3.8 |

[1] ppm = parts per million. Nitrate values on dry basis. To convert values from ppm to percentage, move the decimal point four places left—for example, 602 ppm is .06 percent.

Source: Purdue University

4. Frequent intake of small amounts of a high nitrate feed increases the total amount of nitrate that can be consumed daily without toxic effects. Feed limited amounts several times daily rather than large amounts once or twice daily. With frequent intake of limited amounts of high nitrate feed, the concentration of nitrate in the rumen does not become extremely high at any one time.

Feeding frequency and grain feeding recommendations to reduce the risk of nitrate toxicity refer primarily to milking cows. Extreme caution should be used if bred heifers or dry cows must be fed feeds containing greater than 0.44 percent nitrate ions. Typically these animals are not fed more than once daily, nor are they fed large quantities of grain, the primary ways to prevent toxicity if high nitrate feeds are fed. Young heifers should not be given feeds that are not safe for all livestock to consume.

5. Introduce questionable feed slowly over a period of a week or two so that the rumen bacteria can adapt. All sound management practices that are conducive to a successful feeding program should be followed when high nitrate feeds are fed. In Purdue University experiments, when green corn with 2.29 percent nitrate was fed to unadapted steers, nitrate in the rumen fluid increased measurably within 1 to 1-1/2 hours after feeding. However, each succeeding day the nitrate levels were lower and did not increase again when the experimental forages were fed to the now-adapted animals.

6. Be sure that the ration is balanced. A balanced ration that provides needed nutrients will tend to reduce problems from nitrates in the ration. Rations should be adequate in vitamin A as well as other nutrients. Excessive vitamin A fortification does not appear to be necessary.

## Nitrates in Water

Most well water is lower in nitrates than the maximum 10 parts per million (ppm) nitrate nitrogen ($NO_3N$) that is suggested as being safe for adult humans and mature livestock. Infants and immature ruminants are susceptible to nitrate toxicity when water exceeds 10 ppm $NO_3N$.

When livestock are drinking well water, nitrate toxicity resulting from the water is not likely to occur. Nitrate toxicity from water is most likely to occur when livestock drink water from ponds, road ditches or other surface impressions, which collect drainage from poultry houses, feedlots, heavily fertilized fields, silos, septic tanks, or manure disposal lagoons.

As with feed, frequent intake of water appears to increase the total amount of nitrate that can be consumed daily without harmful effects. Conversely, water consumption limited to only once daily will reduce the level of tolerable nitrates in water before poisoning symptoms appear.

From the information currently available it is difficult to set a maximum nitrate content for water that should be considered safe for mature livestock. Most data tend to suggest toxicity is not likely to occur in water containing less than 100 ppm $NO_3N$, provided that animals are fed a balanced ration that is not high in nitrate, and that sound feeding, watering and management practices are followed.

However, a high level of nitrate in the water can become critical and will contribute to toxicity when nitrate levels in forages approach 1.76 percent.

## Causes and Prevention: Nitrate Poisoning of Livestock

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# Potential for High Nitrate Levels in Drought-Stressed Corn Silage

**Dr. Ron Heiniger and Dr. Jim Dunphy, North Carolina State University**

**Introduction**

As growers consider their options for salvaging drought-damaged corn, the natural option is to harvest the crop for silage. Growers should be aware that elevated nitrate levels in drought-stressed corn silage can result in harm to humans and livestock. Nitrates can accumulate in corn during unfavorable conditions when growth is slow and nitrates are plentiful. High levels of nitrates in corn silage can be toxic to animals.

Symptoms of nitrate poisoning include labored breathing, loss of weight, and lack of appetite. General recommendations are that silages with less than 1000 ppm nitrate-N are safe to feed. Silages with levels of up
to 4000 ppm should be diluted with other feed to achieve 1000 ppm or less concentration in the ration.

Another problem with nitrate accumulation in drought-stressed corn is silo gas. Silo gas is common in all silages but more so in forage crops such as corn and sorghum that accumulate nitrates from exposure to stress situations including drought, hail, frost, cloudy weather and fertility imbalances. 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, dioxide and trioxide. These forms of nitrogen are volatilized as a brownish gas in the atmosphere. This gas is heavier than air and very lethal to humans and livestock.

**Factors that Affect Nitrate Accumulation in Silage**

***Nitrogen Availability –*** Nitrogen fertilizer, manure, or legumes are all sources of nitrogen for corn. The more nitrogen that was available from these sources the greater the likelihood of nitrate accumulation in
corn and the greater the potential for high nitrate levels in corn silage. Because it is difficult to determine how much nitrogen is available to a crop, growers using manure sources as fertilizer for corn should be especially concerned about possible nitrate problems.

***Type of Drought -*** Long, sustained droughts are not as likely to cause accumulation of nitrates in corn as are brief, intense droughts. Drought that occurs early results in less nitrogen uptake by the plant and less problem with nitrate levels in the silage. The worst kind of drought situation is where there is good
early rain and growth by the corn plant followed by dry weather during pollination that results in little or no
kernel development.

Because nitrate is water soluble and highly mobile nitrate accumulation is highest after a droughtending rain. This occurs because the rain moves the nitrates in the soil into the root where they are taken up by the plant. It usually takes 3-4 days before these nitrates are converted by the plant into proteins. Therefore, harvesting corn silage following a drought-ending rain should be delayed until nitrate levels in the plant recede.

***Cloudy Weather –*** Cloudy days often cause elevated nitrate levels because the enzyme that converts nitrates to protein is less active during periods of reduced sunlight.

***Nutrient Deficiencies –*** Deficiencies of nutrients such as phosphorus, potassium, and manganese increase the concentrations of nitrate. In this situation, root uptake of nitrates continues, but growth is limited causing nitrates to accumulate.

***Plant Age and Plant Part –*** Nitrates accumulate most in the lower, older parts of the plant. The stem and roots have higher concentrations than the leaves or ears. A proven method for reducing nitrate levels in corn silage is to chop corn at a greater height above the ground. Leaving 6 to 8" stubble instead of 2 to 4" stubble can reduce nitrate levels by 20%.

## Assessing the Problem

High nitrate levels will probably not be a problem for growers who used nominal rates of nitrogen fertilizer and who have experienced continuous drought since its onset in mid May. Growers who use manure and those who have had intermittent showers that resulted in more forage growth but little or no grain should be cautious about salvaging corn as corn silage. In particular, growers should be very cautious about salvaging corn as "green chop" (silage feed immediately after it is cut). Ensiling corn that is suspected of having high nitrate levels is preferred to green chopping since the fermentation process will decrease nitrate levels by about 50%. It will be important for growers that green chop or growers who apply manure to take a nitrate test before feeding the material to livestock. **WHEN IN DOUBT, HAVE THE FORAGE ANALYZED BEFORE FEEDING.** Even forage with nitrate levels over 1000 ppm nitrate-N can be fed if diluted with other feedstuffs, but it is important to know what you have before you feed it.

## Ways to Reduce Nitrates in Corn Silage

1. Do not feed until the fermentation process is complete. Fermentation will reduce nitrate levels by 30 to 50%.
2. Avoid situations where manure and/or fertilizer results in very high rates of nitrogen applied on a droughty soil.
3. Minimize plant stresses due to nutrient deficiencies.
4. Harvest on bright sunny days.
5. Do NOT harvest for at least 3 days following a soaking rain that comes after a period of dry weather.
6. Raise the cutter to leave at least 6" of stubble.
7. Dilute high nitrate corn silage with feed grains or hay.

## Resources

Cited Publications: Roth, G. and D. Undersander. 1995. Corn silage production, management, and feeding. ASA, CSSA, SSSA special publication. Madison, WI. pp. 41.

# Determining the Value of Drought-Stressed Corn

## University of Maryland Fact Sheet 483

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Drought-stressed corn for grain or silage does not automatically signal disaster, as both crops can provide high quality forage for ruminant animals. Drought-stressed corn or corn that is unpollinated will produce little or no grain crop for the crop farmer to sell, but dairy producers can use the unpollinated corn for silage. On a dry matter basis, the drought-stressed corn will be approximately equal in feeding value to normal corn silage.

**What Is the Feeding Value of Drought-Stressed Corn?**

Results of feeding trials indicate that silage made from plants with few or no ears have 65 to 100 percent of the value of normal silage, when comparing feed efficiency, milk production and growth rate. (These comparisons were made on a dry matter basis). The moisture content of silage made from barren stalks may be high, which can lead to reduced daily dry matter intake and animal performance.

The best way to determine the feeding value of drought-stressed silage is to test the forage. Forage analysis is useful for buying or selling the silage, or for ration balancing. Table 1 is a comparison of forage analyses for normal and drought-stressed silage. Because of the higher crude protein and only slightly lower TDN values of drought-stressed silage, buyers of such silage should be willing to pay almost the same price as they do for well-eared silage of equal dry matter content.

**What Is the Dollar Value of Drought-Stressed Silage?**

There are several ways to determine the dollar value of drought-stressed silage, including pricing formulas and least-cost ration balancing programs. Regardless of the pricing method, both the seller and buyer must value the silage according to how they will use it in their operations. Dairy producers can use silage for needed forage, and crop farmers can use the drought-stressed silage to recover some of the cost of producing the crop.

**Pricing Formulas**
One common pricing formula for silage of approximately 30 percent dry matter is to multiply the market price of corn by six then add $10 to $12 per ton to cover the costs of harvesting and storing the silage. The market price of corn is the price the livestock producer must pay for the grain. If the market price for corn were $3.50 per bushel, the silage would be valued at $31 to $33 per ton.

**Table 1. Comparison of forage analyses for normal and drought-stressed silage**

| Type of silage | DM | CP | ADF | TDN |
|---|---|---|---|---|
| (%) percentage dry matter | | | | |
| Normal Silage | 35 | 8.5 | 28 | 68 |
| Stressed Silage | 25 | 10.0 | 34 | 62 |

To determine the price of silage based on feeding value, approximately 1 ton of 30-percent dry matter silage is equal to 1/3 ton of hay or 8 to 10 bushels of corn. Assuming a hay price of $130 per ton or a corn price of $3.50 per bushel, the silage would be worth approximately $43 and $32 per ton, respectively. Therefore, given the feeding value of the drought-stressed corn and the relative prices for hay and corn, the silage would be worth an average of $37 per ton.

Petersen's constants for corn and soybean oil meal provide a convenient way to determine feeding values for many feeds. In the Petersen method, the value of any feed depends partly on the price of a standard or base carbohydrate-rich feed (corn) and partly on the price of a base protein-rich feed (soybean oil meal). Two factors (constants) are used for each feed that is valued. The constant for corn shows the extent to which computer programs, like the Feed Valuation Template developed by Pennsylvania State University Cooperative Extension, uses Petersen's Constants along with adjustments for fiber requirements to determine the value of feeds relative to shelled corn, 44 percent soybean meal, and average analysis legume hay as the energy, protein and forage alternatives, respectively. The data in Table 2 shows the value of corn silage with different corn and soybean meal prices and with legume hay priced at $130 per ton. Silage analysis was as described previously for "typical" drought-stressed silage and the hay about 85 percent dry matter, 18 percent crude protein, and 50 percent neutral detergent fiber (NDF).

Table 2. Corn silage value using the Pennsylvania State University Feed Valuation Template for corn and soybean meal with average analysis legume hay at $130 per ton1

| Price of shelled corn ($/bu) | Price of 44 percent soybean meal ($/ton) | | |
|---|---|---|---|
| | 275 | 300 | 325 |
| 2.50 | 39.26 | 36.85 | 34.44 |
| 3.00 | 40.32 | 37.91 | 35.49 |
| 3.50 | 41.38 | 38.97 | 36.55 |
| 4.00 | 42.44 | 40.03 | 37.61 |

1 Note: Add (subtract) $4.66/ton for each $10/ton increase (decrease) in hay price.

Since corn silage is an energy feed, the value of corn silage will increase as the price of shelled corn increases and soybean meal and hay prices remain constant. Likewise, the value will decrease as the price of soybean meal increases and the prices of corn and hay remain constant. This is reflected in Table 2.

**Least-Cost Ration Balancing Programs**

One objective of least-cost ration balancing is to provide a specific level of nutrients for the least amount of dollars while maintaining animal performance. The output from least-cost rations can be a valuable tool for pricing feeds relative to each other for a given level of animal performance. The economic value of feeds used and not used in the ration are calculated based on the price and nutrient content of all feeds and how they best meet the nutrient requirements of the animal. Using any dairy ration balancing program that will formulate least-cost rations, the value of drought-stressed silage can be determined for a specific feeding program on a given dairy. In other words, the silage will be valued relative to the cost and nutrient content of all the feeds used on the farm for a group or groups of animals.

To illustrate this concept, the data in Table 3 were generated using the least-cost option of the Ohio State University Ration Evaluator Program. The ration was formulated using a feed ratio of about 50:50 forage to concentrate and of the 50 percent forage, 70 percent of the forage dry matter was silage and 30 percent average quality hay. The silage analysis was as described earlier for "typical" drought -stressed silage and the hay about 85 percent dry matter, 18 percent crude protein, 38 percent acid detergent fiber (ADF), and 50 percent NDF. The ration was formulated to meet the nutrient requirements for 60 pounds of 3.8 percent milk fat and 3.2 percent protein milk.

Dairy producers with adequate hay supplies should use the lower hay price to value the silage. If hay supplies are limited, the higher hay price should be used. The increasing value of the silage as corn prices increase is an expected result, since the silage and corn are competing sources of energy. Drought-stressed silage and the hay used in this analysis are similar in TDN value and at the higher hay prices the hay is less competitive as an energy source, thereby increasing the value of the silage. These dollar values are examples of an average situation and therefore may not be applicable on all dairy farms. To best determine the value of silage in a dairy operation, a customized least-cost ration program is suggested for individual situations.

All three methods for pricing the silage have generated similar answers, answers that can be used by both the seller and buyer. These values are only guidelines to suggest what a buyer could pay for the feed being delivered to the livestock. They are not intended to be absolute values to be demanded by sellers, since there are other considerations. The values calculated in this fact sheet are for fermented silage ready to be fed to livestock. To place a value on standing corn, use the methods described above and then adjust the price for harvest and storage losses. For example, if a dairy producer will be chopping, hauling and filling the trench silo with corn purchased from neighboring grain farmers, the dairy producer would discount the calculated silage price by $6 - $7 to cover harvesting costs, and $4 - $5 to cover storage losses.

Table 3. The dollar value of drought-stressed silage generated from least-cost ration formulation

| **Shelled corn ($/bu)** | **Price of hay($/ton)** | | |
|---|---|---|---|
| | 110 | 130 | 160 |
| 2.50 | 27.00 | 29.50 | 30.00 |
| 3.00 | 29.00 | 34.00 | 35.00 |
| 3.50 | 31.00 | 39.00 | 40.00 |

1 Ohio Ration Evaluation Program 2 Soybean meal valued at $300/ton.

The seller must evaluate the value of the crop to sell as grain, as plow down or on which to receive disaster relief insurance. One or all of these alternatives should be explored in the current market conditions. Finally, the actual selling price of drought-stressed silage varies according to geographic location and the demand for the crop for dairy or livestock feeding.

## What are Some of the Problems Associated with Drought Stressed Corn?

While drought-stressed corn is valuable to both dairy and livestock producers, there are problems related to its use.

1. Because drought-stressed corn has the potential to accumulate nitrates, nitrate toxicity of animals is possible. (For more information, see FS 433, "Harvesting and Feeding Drought-Stressed Corn," and FS 426, "Causes and Prevention: Nitrate Poisoning of Livestock.")

2. Nitrogen oxide gas during fermentation of drought-stressed silage. Precautions must be taken when ensiling drought-stressed silage and when removing the silage from the silo for feeding.

3. The use of nonprotein nitrogen (NPN) on drought-stressed silage is not recommended.

# 2010 Corn Silage Value Examples

**Stan Fultz, Extension Agent, Frederick County**

**Method 1:** Market Price of corn* X 8 = value of standing corn. Add $10/T for harvest costs and 10% for storage losses to get the value of fermented feed.

| Corn market price*($/bu) | Value of standing corn ($/ton) | Value of fermented silage ($/ton) |
|---|---|---|
| 4.00 | 32.00 | 46.20 |
| 4.50 | 36.00 | 50.60 |
| 5.00 | 40.00 | 55.00 |
| 5.50 | 44.00 | 59.40 |
| 6.00 | 48.00 | 63.80 |
| 6.50 | 52.00 | 68.20 |
| 7.00 | 56.00 | 72.60 |

**Method 2:** Feed Value Method

A) one ton of fermented silage equals 1/3 ton of hay

Example: hay value at $150 per ton X .33 = $49.50/ton for fermented silage

B) one ton of fermented silage equals 10 - 12 bu corn

| | | corn price* ($/bu) | | Value of fermented silage ($/ton) |
|---|---|---|---|---|
| 11 | X | 4.00 | = | 44.00 |
| 11 | X | 5.00 | = | 55.00 |
| 11 | X | 6.00 | = | 66.00 |
| 11 | X | 7.00 | = | 77.00 |

(Note: Subtract $15-18 per ton to get standing corn value)

**Method 3:** Petersen's Constants

Value ($/ton) of fermented silage[1] with hay valued at $150 per ton[2].

| corn price* ($/bu) | Soybean meal price* ($/ton) 300 | 350 | 400 | 450 | 500 |
|---|---|---|---|---|---|
| 4.00 | 47.91 | 42.14 | 36.36 | 30.59 | 24.81 |
| 5.00 | 51.14 | 45.36 | 39.28 | 33.81 | 28.04 |
| 6.00 | 54.36 | 48.59 | 42.81 | 37.04 | 31.26 |
| 7.00 | 57.58 | 51.81 | 46.03 | 40.26 | 34.48 |

[1]Subtract $10 per ton for harvest costs and 10% for storage losses to determine the price of standing corn.
[2]Add(subtract) $4.65 for each $10 increase (decrease) in hay price.

*Market price is the price the livestock producer must pay for that commodity from the feed mill, another farmer, or his cost to grow the crop.

Compiled by Stanley Fultz, Dairy Science Extension Agent, University of Maryland Extension, Frederick County Office.

C: my documents\nutrition\silage\2010 pricing updated 7/26/2010

# Determining the Yield of Corn Silage Without Weighing Wagons

This method is for 30-inch rows.

A. Using a tape measure, cut corn stalks from 17 feet 5 inches from a single row or 8 feet 8 ½ inches from two adjacent rows from 5 “typical” areas of the field. Avoid unusual areas such as wet spots, end rows and field edges.

B. Collect and weigh all the cut stalks either together or by sample area.

C. Determine the average sample area weight by taking the total weight and dividing by the number of sample areas. In this case 5.  This will give you the average weight in 1/1000 of an acre.

D. Multiply the results of C by 1000 to get the weight per acre.

E. Divide the weight per acre by 2000 to get tons per acre.

**Example:**

A and B.

| Sample number | weight (pounds) |
|---|---|
| 1 | 37 |
| 2 | 50 |
| 3 | 35 |
| 4 | 45 |
| 5 | 42 |
| Total | 209 |

C. 209 pounds divided by 5 = 41.8 pounds average weight for 1/1000 of an acre

D. 41.8 pounds X 1000 = 41,800 pounds per acre

E. 41,800 divided by 2000 pounds/ton = 20.9 ton per acre

For more information:

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c:\…\nutrition\silage\tons per acre 2010

# Substituting Grain for Hay

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Substituting grain for hay is economical when roughages are in short supply. Since grain costs more per pound than hay, a smaller amount of grain must be fed to economically substitute for hay. This will require restricted feeding of grain.

**Restriction of Hay:** The most economical diets are those diets that have almost no hay at all. Dr. Steven Loerch, OARDC (1993) fed 2 lbs. of first cutting hay, 2 lbs. of supplement, and 12 lbs. of whole shelled corn per cow per day during November and December. The cows received 2 lbs. of hay, 2 lbs. of supplement, and 14 lbs. of corn until spring turn-out. The cow averaged 1300 lbs. in this study. Dr. Loerch recommends taking 3 to 4 days for adjusting the corn and decreasing hay to the 2-pound level. The facilities need to be fairly secure. The following was the supplement used:

| Feedstuff | % |
|---|---|
| Ground Corn | 32.1 |
| Soybean Meal | 45.6 |
| Urea | 4.1 |
| Limestone | 7.8 |
| Dicalcium phosphate | 4.3 |
| Trace mineral salt | 3.2 |
| Potassium source | 2.3 |
| Selenium premix (200 ppm) | .4 |
| Vitamin premix | .2 |

**Partial Restriction of Hay:** Hay-restricted diets will be the most economical, but secure facilities to control hungry cattle may be limiting for some producers. Therefore, for those individuals with limited facilities, substitute grain for only part of the hay or roughage (Steeds and Devlin, 1984; Whittington and Minyard, 1988). A minimum of 1/2 pound of hay per 100 lbs. of body weight is suggested (approximately 5-6 lbs. of hay/day). During extremely cold weather or in pastures with little winter protection, the hay could be increased to 3/4 pound of hay per 100 lbs. of body weight (8 to 9 lbs. of hay/day).

Additional hay can be provided in the form of very mature, low-quality hay or straw bales placed in hay feeders. This could be provided in addition to the previously mentioned hay. This hay, however, must be purchased or produced at a very cheap price to maintain an economical diet. Moldy hay is not cheap at any price.

The amount of grain necessary for each cow will depend on the cow's initial condition. From 8 to 12 lbs. of grain is suggested, with lower conditioned animals receiving the higher amounts. Increase the grain allowance during the last two months before calving.

Include a protein supplement during the last 2 months of pregnancy if low-quality forages are fed. Lactating beef cows can consume a 50% straw-based diet without rumen impaction problems occurring.

Feed the grain in a manner so each animal has an equal opportunity to eat. Sorting the herd into nutritional groups (for example: heifers and old cows versus cows) will aid in limit feeding grain.

Beef cows may become deficient in vitamin A before spring if the roughage fed is made up of winter range or old hay, or if grains make up a substantial part of the diet. Vitamin A may be included in the protein or energy supplement. Vitamin A also can be included in the mineral source. One also can inject 1,000,000 IU of vitamin A. This may be enough for 6 months. A grain-based diet is normally deficient in calcium. Consider using a "finisher" type mineral supplement that has higher calcium content than normal cow-type mineral supplements.

**Some suggestions for substituting grain for hay:**

1. It is generally best to replace only part rather than all of the roughage if your facilities will not hold continuously hungry cattle. In this situation, feed at least 1/2 pound of hay for every 100 lbs. of body weight (5-6 lbs. of hay). In extremly cold weather or without winter protection, increase to 8-9 lbs. of hay.
2. Provide adequate amounts of vitamin A and calcium.
3. All animals will require equal opportunity to eat at the same time.

# Feeding Straw

**FS-6, Reviewed July 2002**
**Roger G. Haugen, Extension Livestock Specialist**
**North Dakota State University**

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Straw is the most common crop aftermath in North Dakota. Straw is a good alternative in rations for cows and sheep if properly supplemented with an energy source like grain and added minerals and vitamins. Differences in feeding value do exist among the straws. Oats is the most palatable and nutritious; barley straw is second and wheat straw has the lowest nutritional value of the main grains. Millet straw is more palatable and higher in energy and protein. Flax straw is lower in feed value than all the others because of its lower digestibility.

Nutrient Contents of Straws

| STRAW | DM % | TDN % | NEm Mcal/lb | CP % | ADF % | Ca % | P % |
|---|---|---|---|---|---|---|---|
| --------100% Dry Matter Basis -------- | | | | | | | |
| Barley | 90.0 | 43 | 0.38 | 4.1 | 52 | 0.37 | 0.11 |
| Flax | 87.0 | 37 | 0.36 | 4.3 | 56 | 0.63 | 0.06 |
| Millet | 86.0 | 51 | 0.47 | 7.0 | 45 | 0.44 | 0.12 |
| Oat | 90.0 | 47 | 0.45 | 4.5 | 50 | 0.27 | 0.10 |
| Rye | 88.0 | 41 | 0.40 | 3.6 | 53 | 0.22 | 0.08 |
| Soybean | 88.0 | 42 | 0.44 | 5.2 | 55 | 1.59 | 0.06 |
| Wheat | 90.0 | 43 | 0.40 | 3.6 | 52 | 0.19 | 0.09 |

Straw one year old could also be considered a feed source. It usually is slightly more digestible and palatable than fresh straw. Rust-infested straw or straw from smut-infested fields apparently present no specific toxicant or irritant to ruminant animals. Nitrate accumulation will not be a factor in grains that have matured adequately to produce ripe seed.

Mature beef cows can utilize a higher percentage of straw in the ration than any other class of farm livestock. Rations utilizing 50 percent straw can be combined with higher protein grass hay, legume hays, and legume-grass hays to result in nutritionally adequate wintering rations for beef cows through the second trimester of gestation. Rations containing up to 60 percent straw by weight have been satisfactory providing high quality roughage comprises the balance of balanced rations. Rations containing about 3/7 straw combined with 4/7 higher quality forage have given very satisfactory performance for wintering cows at the Dickinson Experiment Station.

Pregnant two-year-old heifers can utilize straw up to 25 percent of their ration. Grain straw can substitute satisfactorily for good quality hay when included up to 20 percent of the ration with only modest reduction in rate of gain when included in ground and mixed growing or backgrounding rations.

Medium to low quality roughages such as straw and late cut prairie hay are less palatable than higher quality forages. For this reason, feeding good or high quality roughages simultaneously but separately from poor quality roughages every day often results in shy or timid animals being forced to eat mostly poor quality roughages. This is undesirable.

The total time required to digest roughages in the ruminant digestive tract varies from about two to six days, with the digesting, fermenting forage releasing nutrients while the forage remains in the digestive tract. Virtually all the fibrous components of forage that can be digested by the cow or sheep must be digested in the rumen and reticulum by ruminal microbes, explaining why lower quality roughages must spend more time in the forepart of the digestive tract. This is why "rumen fill" becomes a major factor in determining upper limits of how much lower quality roughages cattle and sheep can consume.

Higher quality roughages digest more rapidly and move through the tract much faster than low quality roughages, such as straw. Because roughage requires at least three days or more to digest completely, it becomes possible to feed only good quality forages one or two days, then feed only straw or poor roughage on alternate days or on third days.

Critical nutrients (digestible protein and minerals) from higher quality forages are being gradually released from good quality forages to supplement and stimulate the microbial digestion of straw eaten on a different day.

When roughages grinding equipment that can produce a uniform ground mixture good with poor roughages is not available, an alternate days feeding schedule will often be the best alternative for ensuring that all animals in the group receive some good and some poorer quality roughage. Most important, it can help ensure that the timid, smaller, or younger animals in the group get opportunity to consume some good quality roughage.

Consumption of straw can be increased by grinding, but efficiency of digestion is actually not improved by grinding when compared to straw consumed in long form.

Except for millet straw, the amount of digestible protein provided by straws is essentially zero, since only about 10 percent of the crude protein of mature grain straw is actually digestible and available to cattle. Straw should be assumed to provide no digestible or useable protein to the ration. Unfortunately, experimental trials fail to show nonprotein nitrogen (urea) to be an effective substitute for natural plant/animal protein in rations containing high level straw. Natural protein sources are far more effective in supplementing the lack of digestible protein from straws.

Straw does not provide enough nutrients to deserve any place in the ration of producing dairy cows. However, small amounts could be used in situations of unusual forage shortage for dry cows and for replacement heifer rations.

Reviewing the basic feed requirements of ewes shows alternative feeding programs using straw can be made. A 150-pound ewe needs 3.5 pounds of feed per day during the first 15 weeks of gestation, 4.5 pounds during the last four to six weeks of gestation and 6-7 pounds per day during lactation. Naturally heavier ewes require more feed. If straw is available, it will make the ration considerably cheaper and still meet the ewe requirements. Suggested daily rations with straw are:

| Gestation First 15 weeks | Gestation Last 4 - 6 weeks | Lactation |
|---|---|---|
| 1.5 lbs hay | 2 lbs hay | 2 lbs hay |
| 1.5 lbs straw | 1.5 lbs straw | 1.5 lbs straw |
| 0.5 lb grain | 1 lb grain | 3.5 lbs grain |

Ideally, hay and straw should be mixed together with the grain to improve consumption of straw. However, if a grinder-mixer is not available, the hay and grain can be fed daily and straw free-choice. If you do not prefer to feed the straw free-choice and rather feed it on a daily basis, feed the straw in the morning and hay in the evening. This should help force the ewes to eat the straw more readily during the day when they are most active.

**CAUTION:** Ewe lambs that are bred to lamb as lambs may not respond as well as the older ewes to feeding straws.

**CAUTION:** Excessive over-dependence on straw for a large proportion of the ration, in combination with inadequate good quality feed and inadequate daily intake of total ration digestible protein, can result in stomach impaction and death. This can happen even when straw is ground. Impaction is most likely to occur after extended periods of 10 days or more of bitter cold weather and in older ruminants that likely are losing some teeth or timid, shy animals low in the social or pecking order.

Low quality grass hay or prairie hay, usually very late cut, can cause the same stomach impaction problem when not adequately supplemented with high quality feedstuffs providing adequate digestible protein.

# Alternative Feeds For Extending Limited Feed Supplies

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Dry weather often leads to over-grazed pastures and short hay crops. Managers need to evaluate optional purchased feeds and decide whether it is most economical to buy feed or sell livestock.

The economics of purchased feed is based on the cost of the feed (including trucking), the animal response to the feed, the value of the animal gain, or the substitution value of the feed compared to alternative feeds. Commodity feeds and by-product feeds are relatively inexpensive this year. Soybean hulls and shell corn can be purchased in tractor trailer load lots for as little as $80-$110 per ton. But who needs a tractor trailer load of feed? This amount of soy hulls fed at 5 pounds per head per day will feed 50 cows for 200 days.

If there is no fall rain and no fall pasture, there will be a 200-day wintering period before spring grazing. If two livestock producers, who have 25 cows each, partnered on a tractor trailer load of such feed, it would allow them to extend their feed supply at a relatively low cost. Purchasing large lots of commodity feeds delivered directly to the farm can reduce the cost of feed by up to a half compared to buying the same feed by the bag at the feed store.

When looking at what supplemental feed to buy, compare feeds based on price and nutritive value, the availability of homegrown forages and their nutritive value, and the nutritional requirements of the livestock being fed. The nutritive value of several supplemental feeds available in West Virginia is presented in Table 1.

**Table 1. Nutritive Value of Commonly Available By-Product Feeds.**

| Feed | DM | CP | TDN | ADF | NDF |
|---|---|---|---|---|---|
| corn gluten feed | 90 | 25 | 83 | 12 | 45 |
| corn, ground shell | 88 | 10 | 85 | 3 | 9 |
| cotton seed | 92 | 24 | 96 | 29 | 39 |
| poultry litter | 75 | 20-30 | 55-60 | | |
| soybean hulls | 91 | 12 | 77 | 50 | 67 |
| soybean meal | 89 | 50 | 84 | 10 | 13 |
| wet brewers grain | 21 | 23 | 66 | 23 | 42 |
| wheat bran | 89 | 17 | 70 | 15 | 51 |

DM-dry matter
CP-crude protein (DM basis)
TDN-total digestible nutrients
ADF-acid detergent fiber
NDF-neutral detergent fiber

**Corn** gluten feed is a high-protein, high-energy feed. It is not as palatable as some other by-product feeds but animals perform well on it. Corn gluten feed can be feed at up to 15 pounds/head/day.

**Corn** is the staple livestock feed commodity in the United States. It is readily available and relatively inexpensive. It a good source of energy, but it is low in protein. It is used regularly to feed growing and finishing cattle, dairy cattle, and sheep. It can be used as a feed for dry beef cows, but caution needs to be exercised that it is used as a cost-effective supplement. If ground-shell corn is fed at more than 2 pounds/head/day with poor quality hay, hay intake and digestibility will be decreased. For growing cattle over 500 pounds in weight, ground-shell corn will provide higher gains than whole-shell corn. For young calves that chew the corn better, whole-shell corn may be a practical alternative to grinding when corn is inexpensive or is a major part of the diet.

**Cottonseed** is a high-energy, high-protein supplement. It is high in energy because it has a high fat content. If fed in too great an amount, the fat in the seed can adversely affect the rumen bacteria and the digestibility of hay in the ration. Whole cottonseed can be fed safely at up to 7 pounds/head/day to a mature cow.

**Soybean hulls** are the skins taken off soybean seeds before they are processed for oil and meal. They are relatively high-energy, medium-protein feed. When fed to dry beef cows they do not suppress the digestibility of low-quality hay. Soy hulls can be fed at up to 10 pounds/head/day to a mature cow with no adverse effects. Pelletted soy hulls will transport and feed better than soy hull flakes. The cost of pelletting may be recovered in reduced shipping cost per ton and ease of use.

**Soybean meal** is a high-energy, high-protein feed. This feed is probably best purchased by the bag or by the ton in small lots because it is used in only small amounts to meet the protein needs of livestock. In most situations, no more than 1 to 2 pounds of soybean meal is needed per cow per day.

**Wet brewers grain** is a high-protein, medium-energy feed. The main difficulties with this feed are the high moisture content that increases the transportation cost per ton of dry matter, and the associated difficulty in storage and feeding. Wet brewers grain can be fed at up to 40 pounds/head/day.

**Wheat bran or midds** (middlings) are moderately high in protein and energy. These feeds are slightly different by-products of the wheat milling industry but are similar in feeding value. Wheat midds can be safely fed at up to 8 pounds/head/day.

The most cost-effective supplemental feed is the one that provides the nutrients needed to balance the nutrients in the available forage. For growing weaned calves on a high-quality grass-legume mixture (hay or pasture) the most cost-effective feed will likely be ground-shell corn for energy. To maintain dry beef cows on low-quality hay, pelletted soy hulls will likely be the best choice to provide energy and protein without reducing the digestibility of the hay. The testing of the available forage and knowing the nutrient requirements of the livestock are necessary information in determining what nutrients are needed from supplemental feeds.

# Ammonia Treatment to Increase Forage Quality

West Virginia University
Extension Service

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8/1999

1. Ammonia greatly improves the feeding value of low-quality forage. Crude protein content can be increased 5 to 7 percentage units and total digestable nutrients (TDN) by 15 percentage units. Neutral detergent fiber (NDF) can decrease by 5 to 8 percentage units.
2. Ammonia does not significantly improve quality of high-quality forage such as alfalfa.
3. Do not ammoniate immature grasses or cereal grain hay. A potent toxin having no known cure can be produced.
4. Procedure.

A. Apply between 1% to 3 % of wet bale weight (assuming moisture content less than 20%). If bales are wetter, use low rate of application (maximum of 1%).
B. Estimate bale weight and calculate total weight of hay that will be treated per batch. Stack the hay loosely (leaving some air space) and place a plastic, not galvanized, tank or tube in the center of the stack.
C. Run a hose from the tube to the outside of the stack.
D. Seal the stack as tightly as possible with good-quality plastic; sealing the edges with soil is a good idea.
E. Multiply total bale weight by application rate (1% to 3%) and buy a tank with just that much ammonia in it. Connect the tank to the hose and open the valve.
F. The hay should remain covered 3 weeks before feeding. It is a good idea to let the bales stand exposed to air for a few days so some of the free ammonia can escape.
G. Analyze the forage before feeding so you can adjust protein and energy supplementation accordingly.

# Stretching Your Horse's Hay Supply During Drought

**L.K. Warren and P.D. Siciliano Colorado State University Extension horse specialist; P.D. Siciliano, Colorado State Univeristy associate professor, equine nutrition.**

**Quick Facts...**

High-fiber roughages should make up the majority of a horse's diet.

Ideally, horses should receive 1.5 to 2.0 percent of their body weight per day as roughage. A minimum of 1 percent of body weight as roughage is needed to maintain normal digestive function.

If grain is needed to maintain body condition, divide the daily portion into several smaller meals. Each grain meal should not exceed 0.5 percent of body weight.

Make any changes to the diet gradually over 1 to 2 weeks.

Provide free-choice access to water and salt.

Drought conditions result in poor hay and pasture production and rising feed costs. Often, horse owners are forced to find alternative feed sources to either "stretch" their limited hay supply, or completely replace it.

Horses should be fed between 1.5 percent and 3.0 percent of their body weight per day in total feed. The amount of feed should be adjusted based on the quality of the roughage, the addition of grain to the diet, the horse's physiological state (e.g., growth, lactation, level of work), and the desired level of body condition (Table 1).

Roughages, including hay and pasture, are the most important component of your horse's diet. Roughages provide essential sources of digestible energy, protein, and some vitamins and minerals. Roughages also supply dietary fiber required for the normal function of the horse's digestive system. Ideally, horses should receive 1.5 to 2.0 percent of their body weight per day as roughage. A minimum of 1 percent of body weight as roughage is needed to maintain gut health.

Roughages, by definition, are feeds that are high in fiber (minimum 18 percent crude fiber). In addition to hay and pasture, there are many other high fiber feeds that can be used to totally replace or partially replace the roughage portion of your horse's diet. Table 2 lists some alternative roughage sources, along with their replacement value relative to grass or alfalfa hay.

Feeds with moderate levels of fiber (11 to 15 percent crude fiber) can also serve as an alternative during drought. These lower fiber feeds cannot totally replace the roughage your horse needs, but they can reduce the amount of hay you have to feed your horse. Start by ensuring your horse receives at least 1 percent of its body weight per day in roughage. Then use moderate fiber feeds to complete the remaining portion of your horse's ration. Table 3 lists feeds with a moderate level of fiber that can be used to replace a portion of the hay in your horse's diet.

| **Table 1: Expected daily feed intake as a percent of body weight*** | | | |
|---|---|---|---|
| **Class of horse** | **Roughage** | **Grain** | **Total** |
| Mature, idle | 1.5 – 2.0 | 0 – 0.5 | 1.5 – 2.0 |
| Working horses** | 1.0 – 2.0 | 0.5 – 1.5 | 1.5 – 2.5 |
| Mare, late gestation | 1.0 – 2.0 | 0.5 – 1.0 | 1.5 – 2.5 |
| Mare, lactation | 1.0 – 2.0 | 0.5 – 1.5 | 2.0 – 3.0 |
| Weanling | 1.0 – 1.5 | 0.5 – 1.5 | 2.0 – 3.0 |
| Yearling | 1.0 – 1.5 | 0.5 – 1.5 | 2.0 – 2.5 |
| *Adapted from NRC (1989) Nutrient Requirements of Horses | | | |
| **Depends on intensity of work. | | | |

**Table 2: Alternative roughage sources that can be used to totally replace or partially replace your horse's hay / pasture.**

| Alternative Roughage | Can be used for **total** replacement of hay | Can be used for **partial** replacement of hay | Replacement Value* | | Comments on Roughage Alternative |
|---|---|---|---|---|---|
| | | | Amt. needed to replace 1-lb grass hay | Amt. needed to replace 1-lb grass hay | |
| Alfalfa hay | ✓ | ✓ | 0.85 lb | 1.0 lb | Higher protein and calcium than grass hays, so will feed less. |
| Grass hay | ✓ | ✓ | 1.0 lb | 1.2 lbs | Many types of grass hay: timothy, brome, orchardgrass, prairie, etc. |
| □□rm□dagrass hay | ✓ | ✓ | 1.0 lb | 1.2 lbs | Type of grass hay imported from sout□ern U.S.; h□y Similar nutrition as other grass h□ys. |
| Millet hay | ✓ | ✓ | 1.3 lbs | 1.6 lbs | Usually contains so□e millet grain; Less nutritional value than most grass hays; May have a laxati□□ e□fect if feed as the only roughage. |
| Sorghum grass | N□t recommended | | | | I□cludes John□ongrass, Sudangrass, & sorghum-Sudan hybrids; May cause neurological problems in horses. |
| Alfalfa hay cubes | ✓ | ✓ | 0.85 lbs | 1.0 lb | Alfalfa that has been chopped and cubed; Si□□la□ nutrition as alfalfa hay (see above). |
| Alfalfa/tim□thy hay cubes | ✓ | ✓ | 0.95 lbs | □.1 lb | Combination of alfalfa and timothy forages;<br>Less protein and calcium than straight alfalfa, but more□than plain timothy. |
| "dehy" alfalfa pellets | ✓ | ✓ | 0.85 lbs | 1.0 lb | □el□eted alfalfa hay; Similar nutrition as alfalfa (see□above). |
| "Compl□te" feed | ✓ | ✓ | 0.70 lbs | 0.85 lbs | Contains a mixture of grains and roughage sources; Designed to be fed without hay; Shoul□ contain at least 15% fiber if no hay is fed. |
| Haylage | ✓ | ✓ | 1.5□□lb | 1.85 lbs | Hay preserved by ensiling rather than traditional drying;□Higher mois□ure than hay, so will have to feed more; Can spoil (mold), so feed contents of bag within 2 to 3 days. |

| | | | | | |
|---|---|---|---|---|---|
| Oat☐hay | ✓ | ✓ | 1.0 lb | 1.2 lbs | Nutritive value similar to grass hays. |
| ☐☐ra | ✓ | ✓ | 1.25 lbs | 1.5 lbs | Oat straw more palatable than wheat or barley☐straw; Bulk☐, high fiber, low in other nutrients; Will require protein supplementation. |
| Beet Pulp | ✓ | ✓ | 0.70 lbs | 0.85 lb | Good source highly digestible fiber; Relatively high in calcium; M☐y require soaking before feeding; Limit to 10 lbs (dry weight) or l☐ss. |
| Soy hu☐ls | ✓ | ✓ | 0.8 lb | 1.0 lbs | High fiber, but more digestible than other hulls. |
| *Replacement values based on average digestible energy content of feeds. Feed amounts may have to be adjusted due to variation between sources of feed and horses. | | | | | |

**Table 3: Moderate fiber feed sources that can be used to replace a portion of the hay/pasture in your horse's diet.***

| Alternative Fiber-Feed Alternatives | Can be used for **total** replacement of hay | Can be used for **partial** replacement of hay | Replacement Value** | | Comments on Moderate Fiber Feeds |
|---|---|---|---|---|---|
| | | | Amt. needed to replace 1-lb alfalfa hay | Amt. needed to replace 1-lb alfalfa hay | |
| Rice bran | ✓ | ✓ | 0.50 lbs | 0.60 lbs | High in fat and phosphorus; More fiber than most grains (similar to oats), but less fiber than hays and other roughages; Diet may require additional calcium supplementation if product is not already balanced by the manufacturer, if 2☐lbs or more rice bran are fed per day, and/or if horse is also receiving plain, unfortified grains (e.g., oats). |
| Wheat bran | ✓ | ✓ | 0.60 lbs | 0.70 lbs | More fiber than most grains (similar to oats), but less fiber than hays and other roughages; High in phospho☐us; Diet may require additional calcium supplementation if 2 lbs or more wheat bran are fed per day and/or if horse is also receiving plain, unfortified grains (e.g., oats). |
| "Pack" cube | ✓ | ✓ | 0.70 lbs | 0.85 lbs | Combination of grains and roughage sources; C☐n be fed without additional hay if pack cube contains at least 15% |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | fiber. |
| Oats | ✓ | ✓ | 0.65 lbs | 0.75 lbs | Not a high fiber feed, but contains more fiber than other grains; Limit to 1% of horse's body weight or less; Ensure at least 1% of body weight is fed a☐ high fiber roughage; Fortification of diet with vitamin/mineral supplement may be necessary. |
| * As long as your horse is receiving a minimum 1% of its body weight per day as hay or some other high fiber roughage (18% crude fiber or greater), the rest of the diet can be made up of lower fiber feeds, such as those included in this table. | | | | | |
| **Replacement values based on average digestible energy content of feeds. Feed amounts may have to be adjusted due to variation between sources of feed and horses. | | | | | |

# Aflatoxins in Corn Will be a Concern This Harvest Season

**Article by Gordon Johnson, Kent Co. Extension Agent, Delaware**

There are many mycotoxins that can be produced by fungi in grain. The types of fungi that proliferate and the toxins that are produced depend on weather conditions, insect damage, diseases present, stress encountered and variety interactions. In a dry year, aflatoxins are the predominant mycotoxin present in corn at harvest. Aflatoxins are produced by the mold fungi *Aspergillus flavus* and *Aspergillus parasiticus*. These fungi can be recognized by their yellow-green or gray-green colors respectively on corn kernels.

Aflatoxins are often a problem in hot, dry years on drought stressed corn. According to an Iowa State Extension publication on the topic 'The prime conditions for the fungus to produce toxin are warm August nights in a period of drought' which describes most of Delaware (and Delmarva as a whole) at this time.

Aflatoxins are potent poisons and can contaminate feed ingredients leading to health and performance problems in animals (dairy, beef, swine, poultry). They are also considered carcinogens and are a human health concern.

A rapid test is often used on corn for initial indication of aflatoxin. This is done with a black light at a wavelength of 365 nm. Contaminated corn will give off a greenish-gold fluorescence. More than four particles showing this fluorescence in a five pound sample indicates levels of aflatoxin above 20 parts per billion (ppb), the initial level of concern. However, this is just an initial screen. More accurate testing is necessary to assess actual levels. This is done using commercially available test kits or by sending samples to an analytical laboratory. Both the Delaware Department of Agriculture and Maryland Department of Agriculture can provide aflatoxin testing for growers (free of charge) in those states. This is particularly of use for growers who store or feed their own grain.

The fungi that produce aflatoxins are found in plant residue. They produce many spores that can infect silks or kernels of corn, usually through insect wounds. The Aspergillis fungus grows best in hot, sunny, dry daytime weather conditions with warm nights. Drought damaged corn is most susceptible. Insects can further spread the fungus when feeding on an ear.

Managing for aflatoxins begins with assessing fields for insect or other damage. Fields with heavy European corn borer pressure, corn earworm feeding on tips, bird feeding, or storm damage should be noted and tested before harvest. If a field is suspect, samples should be collected form 20 or more locations, taking at least 5 pounds of grain from every 5 acres. Dry samples to 12-14 % moisture or freeze to stop aflatoxin development (aflatoxin can increase in stored samples if at higher moistures) and immediately deliver to the laboratory for testing. Dried samples can be shipped in paper bags (do not use plastic). Scout fields at black layer and again two weeks before harvest.

If fields test positive for aflatoxins or you expect high levels, you should make provisions to harvest those fields first and dry the grain quickly. Adjust combines to minimize kernel damage as this can cause the fungus to increase. Grain with high levels of aflatoxin should be stored separately if possible. Grain storage facilities should be carefully cleaned to minimize infection of incoming grain by *Aspergillus* and other mold spores. Avoid grain damage during handling and if possible, clean corn before storage (screening). Do not store grain in non-aerated conditions for more than 4 hours (trucks, wet tanks, combine bin). Aflatoxin production is effectively stopped if grain is dried to 12% moisture. It proliferates at a moisture of 18% and temperatures above 80° F.

Corn that is contaminated at levels greater than 20 ppb may not be sold for interstate commerce. It can be used locally for livestock and poultry if under certain levels, but not for lactating dairy. Check with your grain buyers on how they will handle aflatoxin contaminated corn. Blending with non-contaminated corn to reduce levels to below 20 ppb may be an option. Cleaning grain by screening or a gravity table can also reduce aflatoxin concentrations.

For more information see these web sites:

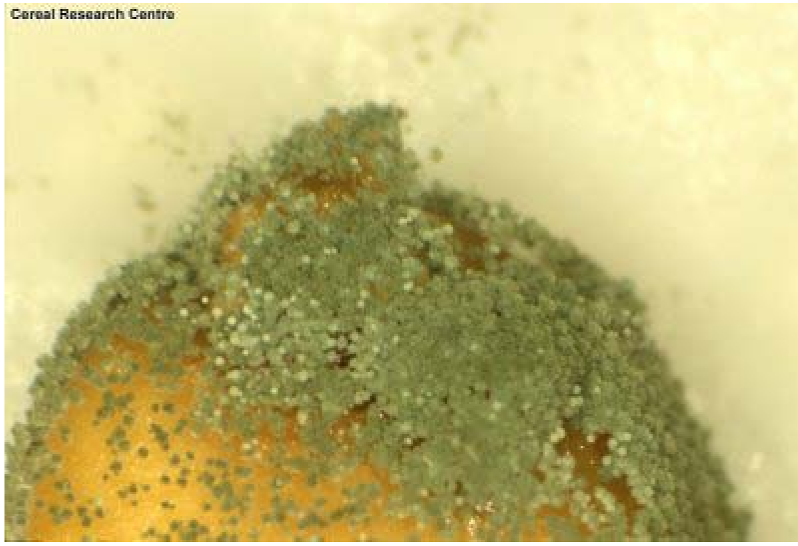
Aflatoxins in Corn from Iowa State University Extension (PDF)
http://www.extension.iastate.edu/Publications/PM1800.pdf

Minimizing Aflatoxin in Corn from Mississippi State University
http://msucares.com/pubs/infosheets/is1563.htm

Aflatoxins in Corn from the University of Kentucky (PDF)
http://www.ca.uky.edu/agc/pubs/id/id59/id59.pdf

Reducing Aflatoxin in Corn During Harvest and Storage from the University of Georgia (PDF)
http://pubs.caes.uga.edu/caespubs/pubs/PDF/B1231.pdf

## Aspergillus Fungus that Produces Aflatoxin in Corn




Aspergillus on Corn
*Photo courtesy of [Cereal Research Centre, AAFC]*

Aspergillus Ear Rot. This is the fungus that produces aflatoxin.
*Photo by Alison Robertson, Department of Plant Pathology, Iowa State University*

## Aflatoxin Tolerance Table

**Table 1. FDA guidelines for acceptable aflatoxin level in corn based on intended use.**

| Intended use | Aflatoxin level (ppb) |
|---|---|
| Milk (Dairy Feed) | None detected |
| Corn of unknown destination | <20 |
| Corn for young animals | <20 |
| Corn for dairy cattle | <20 |
| Corn for breeding beef cattle, swine, and mature poultry | <100 |
| Corn for finishing swine | <200 |
| Corn for finishing cattle | <300 |

Table from Iowa State University Extension Publication PM1800 Aflatoxins in Corn

*Prepared by Gary Munkvold, extension plant pathologist; Charles Hurburgh, professor of agricultural and biosystems engineering; and Julie Meyer, plant pathologist.*
*Updated by Charles Hurburgh, professor of agricultural and biosystems engineering; Dan Loy, professor, animal science and Alison Robertson, extension plant pathologist.*

# *Drought and the Animal*

# Drought Management Strategies for Beef Cattle

**Johnny Rossi and Robert Stewart, Extension Animal Scientists**
**University of Georgia**

Drought conditions are a yearly occurrence in Georgia and every cattleman should have a plan in place to minimize the effects of drought on the farm's finances. Drought conditions can cause several problems such as reduced pregnancy rates, lower milk production which lowers weaning weights, and loss of body condition of the cow, which leads to a higher supplementation bill in the winter. Animals must be supplemented with purchased feeds if adequate animal performance is going to be achieved. Supplemental feeding will add to the cost of production. Therefore, supplemental feed costs need to be kept as low as possible and feed purchased should be kept to a minimum.

## Evaluate stocking rates

If grass runs out every time there is a dry spell, you are probably overstocked. Grass should only completely run out when there is a long term drought. If there is a large quantity of low quality forage available after a long drought, the farm is probably understocked.

## Nitrates

Nitrate toxicity is a concern when grazing drought stricken pastures fertilized heavily with nitrogen. The only way to know if there is a potential problem is to test the forage.

It is safe to graze cattle on forages that have 5,000 or less ppm nitrates. Forages most likely to be toxic are millet, sudangrass, sorghum x sudangrass hybrids, and corn. Do not put hungry cattle on potentially toxic forage as they can consume high amounts of nitrates in a short period of time. Feed the cattle hay before turning them onto the pasture, or introduce the pasture slowly by grazing only a couple of hours each day. Wait for at least five days after a rain before turning the cows onto a pasture with high nitrate levels.

## Deworm

Parasites can reduce cow performance and rob your cows of expensive supplemental feed. Cows will graze closer to the ground when forage is in short supply, which can increase the number of parasites ingested. Deworming now will reduce the chance for reinfection because of hot dry weather and also reduce the number of parasites in the pasture next year.

## Culling

The most often used method for reducing feed needs during a drought is to sell a portion of the herd. Consider pregnancy testing and culling cows that are open, old and low producers, and that calve late in the calving period. This will provide more feed for younger, more productive cows.

## Early weaning calves

Most cattle producers in Georgia market calves at weaning time. Weaning weights are almost always negatively affected during a drought situation. Producers can either sell calves at younger ages, wean and feed calves separately from cows, or supplement the cow herd with stored or purchased feeds. Dry cows in early to mid pregnancy are at their lowest in terms of nutritional requirements. These cows can be maintained on poor quality forages with little or no supplemental feed.

## Early Weaning

1. A dry cow will require about 30 to 40 percent less energy and 50 percent less protein feed than a lactating cow.
2. Cows that you plan to cull after calves are weaned can be culled now. This will reduce the amount of feed needed. The normal culling rate is approximately 15 to 20 percent each year. Culling combined with early weaning will cut the feed needed for cows by at least half.
3. In addition, low producing dry pastures may be enough to maintain cows that have had their calves weaned. Maintaining cow and calf pairs on dry pasture will result in very calf low growth rates as well as lowered body condition scores and conception rates in cows.
4. Improved conception rates. Early weaning the calf at 120 days of age or less has been shown to greatly improve conception rates when grazing the same forage as cows that continue to nurse their calves. In addition, cow body condition is improved when calves are early weaned, and cows will require less supplemental feed in the fall and winter to regain body condition.
5. Calves can be fed higher quality supplemental feeds, and calf weights will not be decreased at seven months of age, which is the time calves would normally be weaned. Early weaned calves are extremely efficient, often requiring 4 to 5 pounds of feed per pound of gain when fed a high grain diet.

## Rations for early weaned calves

Pasture or hay without any supplemental feed will not work for early weaned calves. Calves will not gain enough weight to justify early weaning. Calves that are early weaned can be fed a typical high grain feedlot ration. Rations for calves that are early weaned should contain 70 percent or greater TDN and 16 to 18 percent protein. The protein level can be lowered to 13 to 14 percent when calves weigh 450 pounds. Researchers at Oklahoma State University have used a diet of 45 percent corn, 30 percent cottonseed hulls, 18 percent soybean meal, 4 percent molasses, 2 percent calcium carbonate, 0.5 percent dicalcium phosphate, 0.5 percent trace mineral salt, and Vitamin A for calves weaned as early as six to eight weeks old. Calves should consume 3 to 3.5 percent of body weight of this ration once they are adapted to the diet. Include an ionophore (Rumensin® or Bovatec®) to reduce digestive disorders and improve feed efficiency.

## Creep feeding

If early weaning is not an option, then creep feeding is an excellent alternative. The most profitable time to creep feed is during a drought. A mixture of 75 percent grain and 25 percent soybean meal can improve gains by 0.5 to 1.0 pound per day. Another widely used creep feeding option is 100 percent soybean hulls or a mixture of 50 percent soybean hulls and 50 percent corn gluten feed.

## Feeding cows grain-based diets

If pasture is depleted after the cow herd is culled, then supplemental feeding will be necessary. Hay is the most often used option, but certainly not the only option. Grains and by-product feeds are often cheaper per unit of energy than hay. This is especially true during a drought situation when there is a lot of competition for any available hay. Several research studies have shown that limit feeding high grain rations based on grains or by-products will successfully maintain a dry cow. The grain mix (14 percent protein) is usually fed at 1.2 to 1.5 percent body weight. At least 4 pounds of hay or a roughage such as cottonseed hulls should be fed to maintain normal rumen function. A lactating cow will require about 30 percent more feed than a dry cow. Limit feeding grain supplements requires a high level of management, and producers can seek help from their local extension agent with implementing this management practice.

Another option is to feed a grain/roughage mix free-choice. The rations generally contain 50 percent roughage such as peanut hulls, cottonseed hulls, or hay. The grain portion (50 percent of diet) should contain at least 15 percent protein for lactating cows and 12 percent for dry cows. A few examples for the grain mix are 85 percent corn and 15 percent soybean meal, 50 percent corn gluten feed and 50 percent soyhulls, and 60 percent corn and 40 percent whole cottonseed. Many by-product feeds and grains can yield acceptable performance. The local county extension agent can help formulate a free-choice ration.

## Grouping cows

It is important to group cows by nutrient needs, such as production status (dry vs. lactating), age, and body condition. Grouping cows can avoid over or under feeding a particular group, which will reduce supplemental feed costs. Pregnant cows may lose body condition when grazing drought stressed pasture. Therefore, body condition score cows at least 60 days prior to calving and adjust ration to ensure cows are at least a condition score of 5 at calving time.

## Supplements for forage

Many producers may be feeding hay or have limited grazing available. Adequate nutrition can be achieved by supplementing energy, protein, minerals, and Vitamin A. The following supplements can be considered.

1. ***Range cubes* -** They require no feed troughs, are convenient, but expensive. Feeding 3 to 5 pounds per day is generally recommended. However, more can be fed if needed.
2. ***Liquid Supplements, molasses blocks, and protein blocks* -** These are convenient, but expensive. Daily consumption will generally be less than 2 pounds. Liquid supplements provide supplemental protein but will not provide enough supplemental energy. Cows should be fed 3 to 5 pounds a day of supplemental energy.
3. ***Grain, by-products* -** A mix of 75 percent corn and 25 percent soybean meal can be fed at 3 to 5 pounds per day to maintain animal performance. By-product feeds such as soyhulls, citrus pulp, corn gluten feed, wheat middlings, cottonseed, and distillers grains can provide economical sources of protein and energy. These feeds are equal in energy to corn when fed as a supplement to a forage-based diet. A disadvantage to using by-products is that some operations may not have storage facilities and most by-products must be purchased in truck load lots to be economical. However, several producers can purchase a portion of a truck load to ease this problem. For

smaller quantities, producers may want to store feed in a gravity flow wagon or store feed in large bags that can hold up to a ton of feed. It will have to be handled by hand to feed but may be the only economical feeding method available. These by-products vary widely in protein and feeding recommendations, so, you may want to ask your local county extension agent for help when balancing rations using by-products.

4. ***Self-Fed Supplements* -** Rations containing a protein supplement with salt can provide 2.5 to 3.5 pounds of supplement per cow per day when fed fair quality hay free-choice or limited grazing. The supplement should consist of one-third each of corn, cottonseed or soybean meal, and salt. Reduce salt to 20 percent for an intake of 4.5 to 5.5 pounds per day. Approximately 10 to 15 percent of the salt should be in the form of trace mineral salt and the remainder can be plain white salt. Do not use trace mineral salt as the only salt source as a trace mineral toxicity could occur. Be sure plenty of fresh water is available when feeding salt limited diets. Use limited supplement intake with salt only with mature cows. Cows will vary in their consumption of salt and the salt level may need to be continually adjusted during the feeding period. Provide Vitamin A at the rate of 7,000 International Units per pound of feed (14 million units per ton). Cattle should be hand-fed for one week prior to self-feeding in order to adjust to these rations.

## Summary

Culling priorities should start with open cows first, old cows second, and low producers third. Early weaning can greatly reduce feed costs and allow cows to maintain a body condition score of 5, which should lead to optimal (> 90 percent) pregnancy rates. Calves weaned earlier than normal require a nutrient dense diet that must be either a grain based diet or high quality forage such as ryegrass plus a grain supplement at approximately 1 percent of body weight. A variety of supplements can be used to replace a portion of the forage needs during a drought. When the forage supply is exhausted, limit fed grain based diets are an economical, effective solution to feeding cows.

**Bulletin 1323/December, 2006**

# Feeding Strategies During Drought

**Dr. Mark L. Wahlberg, Extension Animal Scientist, Virginia Tech**

Cattle and sheep producers in some parts of Virginia are already experiencing feed shortages due to drought conditions. For those of you who are not in that shape, don't let your guard down. Two weeks of hot and dry weather can shift conditions very quickly. In this article I want to provide reminders for the strategies to consider when drought causes feed shortages.

Some nutritional ground rules have to be taken care of. Cows with calves have higher requirements for nutrition than do females that have been dried off. They also have a bigger appetite. High levels of nutrition are needed not only to support milk production, but also to enable the female to successfully re-breed. Cattle require a minimum of 1/2 % of their body weight in the form of effective fiber or long forage daily. So, high level of nutrition and supplementation should be continued through the end of the breeding season.

**Consider the following options with cows prior to the end of breeding:**

- Feed hay to make up for the pasture that isn't there. OK if you have enough hay made. Calculate hay needs for a normal winter feeding season, and add 25% to that for such things as feed wastage and a harsh winter season. Don't waste hay - use the recommended methods such as hay feeders, unrolling, etc. Limit the time cows have access to hay each day. Four to 6 hours each day will probably give them enough feed, if the hay is of good quality.
- Limit pasture or hay and supplement with grain. Nutritionally, one pound of grain replaces the energy in two pounds of hay. If a cow can eat the equivalent of 25 pounds of hay, and you limit her to 10 pounds of hay, the extra nutrition needed can come from around 7 pounds of grain. However, be aware that the cow will not be fed all she can eat, so she will be hungry with this feeding program. Good fences are needed, and she will gnaw on anything that she can find. But her nutritional needs will be met.
- Buy hay if you don't have it. Bad idea. Energy is the needed nutrient. Grain is a cheaper source of energy than is hay. As long as the minimum amount of fiber is provided to the cattle (equivalent of 5 to 8 pounds of hay per head per day), the rest of the diet can be in the form of grain. So, if you're going to buy feed energy, buy grain and not hay.
- Open all the gates so the cattle can wander over the whole place and find enough to eat. Another bad idea. This will just delay the regrowth once moisture falls. Concentrate the cattle in a smaller area and bring feed to them. Allow the balance of the property to grow grass that can be grazed later once there is enough of it.
- Creep feed the calves to "lighten the load" on the cows. Nice idea, but it doesn't work that way. Calves prefer milk to anything else, so they will nurse to the point of removing all the milk the cow can make. Then they'll eat the creep feed. Calf forage intake is reduced, but not milk consumption. The calf grows well, but the cow is still pushed hard. The only way to really lighten the cows' load is to wean the calves.

**Strategies to consider once the breeding season is over can be more dramatic.** Remember, the critical nutrient needs occur from calving through breeding. So when the cows have had enough opportunity to get bred and you pull the bulls, level of feeding can go down.

- The best thing to do to help the feed situation is to wean the calves. Calves that are 3-4 months old and weigh 300 pounds or more are able to make their living on their own. For the cow, once she is dry here appetite is less, and her nutrient requirements are substantially less. Once the calf is weaned it will be easier for the cow to hold her condition and not milk down to a very thin status. Limited forage plus grain can be used to maintain the cow fairly economically.
- Early weaning of calves requires that a high quality grain-based diet be fed to the calves. Palatable grain mixes of 14-16% protein, plus good quality mixed pasture or mixed hay should be offered. Little calves will not need a lot of pasture if they are fed grain in addition. Stocking rates of 4 to 6 calves per acre of pasture are reasonable. Feed efficiency of light calves on grain diets is very good. Their young digestive system can't hold a lot of feed, and they are at an efficient stage of growth. Rate of gain is good on a fairly low level of feed intake.
- Make certain you are feeding cows that are worth keeping. Carefully evaluate cows for soundness, freedom from disease conditions, reproductive performance, and other important criteria. Cull those that don't measure up.

Alternatives to pasture must be found when drought causes the grass to not grow. Substitute forage sources are not prevalent, and are usually expensive. In addition to hay, some possibilities are Cottonseed hulls, Peanut hulls, Broiler litter, but cost and availability are limitations.

Grain is a more cost-effective source of nutrition. Whole shelled corn and whole barley can be used interchangeably. In addition, soy hulls, corn gluten feed, wheat midds, and distillers grains have energy content similar to corn. Brewers grains is somewhat lower in energy, but may be useful if it can be purchased at a fairly low cost. **Caution** Some byproduct feeds are available in high moisture form. Do not be suckered into a low cost per ton for a high moisture feed. A feed with 25% dry matter that costs $35 per ton is actually $140 per ton of dry matter. Compare price on an equal moisture basis. Your local Extension Agent can provide assistance.

High grain with limited roughage will likely be the lowest cost feeding program for cows. When feeding this type of diet, though, the mineral program must be changed. Because of the high grain level, a mineral that has a lower Phosphorous and higher Calcium level needs to be used, similar to what would be fed to a steer in a feedlot.

**Finally,some thoughts on forage management.**

- Don't graze too long on short grass - it will take even longer to recover.
- Better to concentrate cattle in one area that is "sacrificed" and feed them there.
- Let the grass grow back before grazing. Grazing short grass just means you will have short grass for even a longer time.
- Nitrate toxicity is a concern with rapid forage growth following drought. Especially risky is a field that has been well-fertilized with nitrogen. All the more reason to wait a few weeks until grazing once growth resumes.
- Alternate forages should be considered, especially the annuals. Millet and other summer annuals
- grow well in hot conditions, but they also require some water.

Lack of rain and hungry cattle are a bad combination. Many cattlemen have found the nutritional solution to this problem with grain feeding and limited hay. Early weaning of the calves further eases the feed shortage and enables calves to continue to grow.

# Early Weaning -- Should I Wean Now??

**John B. Hall, Extension Animal Scientist, Beef, Virginia Tech**

The extremely dry spring and early summer are not making things look particularly good for the rest of the summer. Some parts of Virginia have received as much as 2 inches of rain in the past two weeks. However, much of Virginia west of the Blue Ridge Mountains and in the piedmont areas is still extremely dry. In this situation, producers should ask themselves a few important questions:

1. How can I most economically make it through the dry period?
2. What are my feeding options?
3. Even if I feed my cows, if I leave the calves on them what body condition score will they be when normal weaning time comes around?

Many cows in Virginia entered the calving season thinner than normal. The forage situation this spring and summer has not allowed many cows to improve body condition. **The key things we want to achieve this summer is to keep cows in BCS 4 - 6 and have a decent calf to sell this fall or summer (if fall calving).** The options are pretty simple either feed: 1) a lactating cow and let the cow feed the calf, or 2) creep feed the calf and minimal feed to the cow or 3) early wean the calves and feed the calves and dry cows or 4) sell calves and feed dry cows. For fall calving operations option 4 probably makes the most sense, but for spring calving herds option 4 would result in significantly reduced income.

*Option 1.* Feed the lactating cow and let the cow feed the calf. If you are in one of the areas of the state where adequate rainfall has occurred and the grass is coming back, this is a good option. You might also consider this option if you have hay fields to graze and your hay supply for this fall and winter looks good. To maximize calf growth, calves should be creep grazed in to high quality forage. If your pasture is limited, this is the most expensive and risky way to go. (See table 1 for diets).

*Option 2.* Creep feed the calf and minimal feed to the cow. If your pastures are in short supply, but you don't want to wean calves this is an option. Essentially, you are limit feeding the cow or feeding her more like a cow in late gestation rather than a lactating cow. Once the calves are worked up on a good creep feed you can begin changing the cow's diet to the limit fed diet. However, cows must be in good body condition because without weaning they will lose some body condition. "Creep Feeding Beef Calves" is a new publication that provides information on diets for creep feeding and managing creep fed calves.

*Option 3.* Wean and feed calves and dry cows. For many operations in Virginia, this is the best option if the drought continues as expected. Early weaning will keep cows from losing weight, improve value of the calf and help cows breed back faster next year. Perhaps, most importantly, early weaning will reduce your feed costs compared to trying to feed a lactating cow. In addition, early weaning will keep you from being forced to sell your calves when many other producers are selling their animals due to drought.

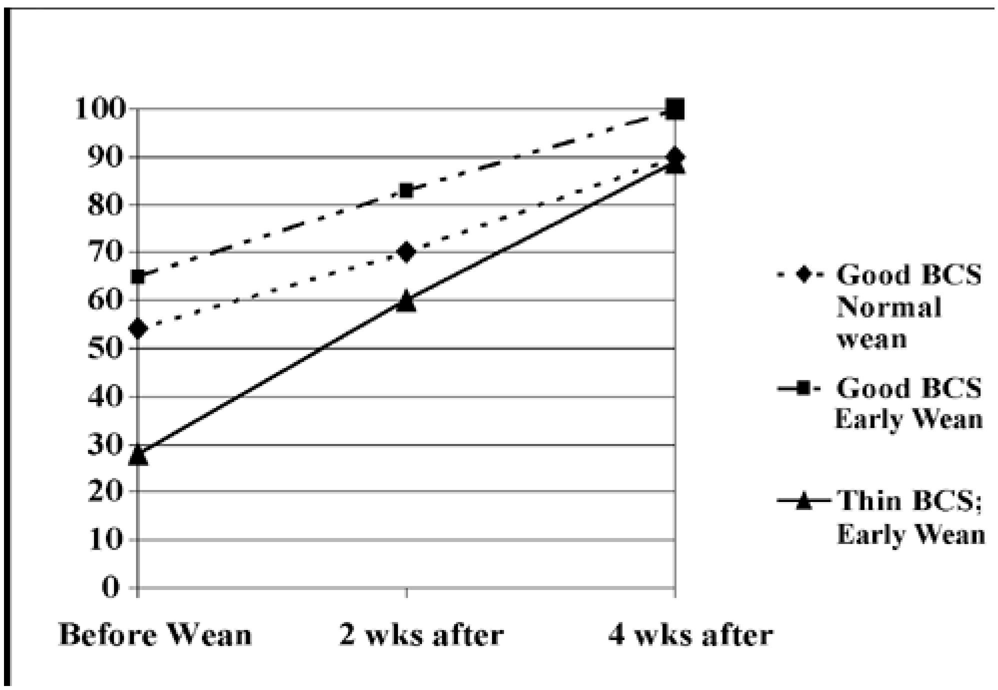
Table 1. Some examples of diets for 1200 lb cows with good milking ability Hay in the following table is 50% TDN and 10 % Crude protein and $40/ton.

| Production stage | Diet | Cost |
|---|---|---|
| Dry cow, middle trimester of pregnancy | 26 lbs. hay + free choice mineral<br>OR | 55¢ /day |
| | 5 lbs hay + 19 lbs of a 80% poultry litter 20 % corn mix and minerals for use with poultry litter | 52¢ /day |
| Dry cow, last trimester of pregnancy | 22 lbs hay + 5.5 lbs soy hulls or barley and free choice mineral<br>OR | 65¢ /day |
| | 5 lbs hay + 22-24 lbs of a 80% poultry litter 20 % corn mix and minerals for use with poultry litter | 62¢ /day |
| Lactating cow, 1st 3 months of lactation | 17.5 lbs hay + 14.5 lbs soy hulls or barley and free choice mineral<br>OR | $ 1.19/day |
| | 16.5 lbs hay + 13.5 corn + 2.2 lbs soybean meal and free choice mineral<br>OR | 78¢ - 89¢ /day |
| | 5lbs hay + 24-28 lbs of a 80% poultry litter 20 % corn mix and minerals for use with poultry litter | 71¢ /day |
| The diets in this table are examples. Actual feed analysis of hay and by-products are needed to calculate actual feed required for a specific herd. In addition, a good estimate of cow weight is also needed. Contact your extension agent or nutritionist for exact diets for your herd. | | |

Research from Oklahoma, Illinois and North Carolina demonstrated that early weaned cows were in better body condition at the beginning of the winter than normal weaned cows. The increase in body condition was related to the age of the calf at weaning. The younger the calf was at weaning the fleshier his dam was at the start of winter. Depending on the study, calves were weaned anywhere from 65 days to 150 days old. Early weaned cows generally gained 0.5 to 1.5 body condition scores. If your cows are BCS 3 or less you should early wean the calves now. Herds with cows in BCS 4+ should consider early weaning soon before cows lose too much condition.

Thin cows that are early weaned have a better chance at breeding back this year. If you are have a March - April or April - May calving herd, weaning your calves now could give you a big boost in pregnancy rates this fall. The percentage of thin cows cycling increased steadily in the weeks after early weaning (Figure 1). By the end of the breeding season, just as many early weaned thin cows were pregnant as good body condition score cows.

Figure 1. Percentage of cows cycling at different time before and after early weaning




Overall in severe drought years, early weaning is a good option to keep cows in good body condition and increase pregnancy rates while lowering feed costs. Nutrition of the calf is very important in order to insure profitable weaning weights. Dr. Mark Wahlberg covers nutrition of early-weaned calves in a companion article in this livestock update.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# Management of Early-Weaned Calves

**Mark L. Wahlberg, Extension Animal Scientist, Virginia Tech**

Beef calves are normally weaned from 6 to 10 months of age. However, they can be weaned as early as 60 days of age. Early weaning may be a wise management practice because of

- Thin cows that need to pick up body condition
- Low quality forage
- Drought that reduces forage supply

In a companion paper by Dr. John Hall the management of the cow in an early weaning program is discussed. In this article will be factors related to management of the early-weaned calf, including health and nutrition.

Cows require about twice as much protein and TDN (energy) in their feed when nursing a calf than when they are dry. As the calf grows he begins to supplement his milk diet with grazing. When feed resources are limited in either quality or quantity, the cow's milk production is reduced. Gains of the nursing calf can be greatly reduced because both pasture and milk supply are restricted. In this situation early weaning is a strategy that should be considered.

<u>Creep Feeding</u> is one alternative that is often considered. With creep feeding a supply of high quality feed or pasture is made available to the calves but the cows are prevented from accessing this feed. Calves are not weaned. If creep feed is made available beginning 2 or 3 months prior to normal weaning age, gains are increased 1/2 to almost 1 pound per day, resulting in 50 to 75 pounds more weaning weight. See the VCE publication, Creep Feeding of Beef Calves (publication number 400003) for more details about this management practice.

Although creep feeding may fix the problem with calf nutrition, the cows are still lactating and still have fairly high nutrient requirements. Creep feeding does not greatly reduce the nutrition problem in the cow, especially when drought conditions persist.

A second problem is forage quality. If grain type creep feeds are used, the pasture quality and supply shortage is not changed. Consequently, calves substitute grain (expensive) for forage (low-cost) in their total diet. In many experiments, it takes more than 8 or 10 pounds of creep feed to produce an additional pound of weight gain in the calf. Therefore, this practice is sometimes not cost effective, especially when feed is high and calves are low-priced. Of course, if creep grazing of high quality pasture is used, the extra pounds of calf gain are produced much more economically.

<u>Early Weaning Health Concerns</u> -- Calves can experience considerable stress due to weaning at a young age. They need to be properly vaccinated for the clostridial diseases (the typical 7-way vaccine) and perhaps for respiratory diseases. Consult your veterinary for recommendations. Calves can experience problems from coccidia and worms. A feed additive that controls coccidiosis should be included. Rumensin, Bovatec, Deccox, and CoRid are approved for such use. Deworming, especially if calves are 3-4 months or older, is highly recommended. Although not a health practice, at the time of weaning and processing all calves not kept for replacements should receive one of the approved implants to promote weight gain.

Starting on Feed -- Calves should be weaned in a fairly small pen with some type of shelter. Pens of less than 20 calves are best to reduce competition and allow good observation of all animals. Feed and water should be easily accessible and recognized. Because calves are still learning about feed and water, an older calf that is already weaned can be put with the new calves to serve as a teacher. The younger ones will follow the older one to feed and water and become adapted more quickly.

Rations for Early Weaning -- Calves will not eat much feed right after being removed from their dams. Consequently, the feed needs to be very palatable and highly nutritious. Quality is much more important than price when starting calves on feed. In Oklahoma a recommended starter ration is 64% rolled corn, 20% soybean meal, 10% cottonseed hulls, and 5% molasses, plus vitamins and minerals. A successful ration used in Illinois research is 30% chopped hay, 18% soybean meal, 50% cracked corn, plus vitamins and minerals. These rations contain roughage and are designed to be the only source of feed available. Consumption should reach 4 to 5 pounds per head per day within 10 to 14 days.

When offered long hay, some calves will fill up on it and not eat the grain mix. If long hay is the roughage source, it must be limit fed, and care must be given to assure consumption of the grain portion of the total feed offered. Chopping of the hay and making a total mixed ration solves this problem.

Young calves are still developing their rumen, and therefore cannot utilize some feeds as well as more mature cattle. Such feeds as urea or broiler litter that contain nonprotein nitrogen should not be used in starter rations for young calves.

Once calves are over the stress of weaning and are eating at least 1 1/2% of their body weight in the starter ration each day, they are ready for the next step. They can remain in the drylot and receive a growing ration based on harvested feeds, or go to pasture for a forage-based growing program.

If pasture is to be used, quality must be excellent. Calves will not gain well on lower-quality forages. In a North Carolina trial with early-weaned calves on pasture, the poorest gains were on a tall fescue-clover pasture, and the best gains came from grazing pearl millet. In this trial, calves were supplemented with either 1% of their body weight in ground ear corn, or corn was available at all times in self-feeders. Gains of the limit-fed calves ranged from 1 to 1.8 pounds per day, and the self-fed calves gained 1.5 to 2.2 pounds per day. Pastures used, ranked from lowest gain to highest gain, were tall fescue-clover (mostly fescue), bluegrass and orchardgrass with white clover, clover-fescue mix (50% white clover), and pearl millet. The calves, which weighed 330 pounds when weaned in July, were stocked at 4 head per acre, and pastures were rotationally grazed.

Effects Seen Later On -- Calves that are weaned at 2 to 5 months of age and put on feed should weigh at least as much at normal weaning time as they usually do. Gains of 3 pounds per day were recorded by researchers in Illinois on calves weaned at 150 days of age and fed a high grain ration. However, in Oklahoma, calves weaned at 65 days and grazing native range with a high protein supplement weighed 60 pounds less than those weaned at 7-8 months. This emphasizes the importance of feed quality to get early-weaned calves to gain weight rapidly.

Several trials in Illinois were run to compare calves place on high grain feedlot rations beginning at 5 months of age compared to calves that were older at the start of feeding. Cattle were fed to slaughter weight, killed at a similar backfat thickness, and carcass data was obtained. When compared to normal weaning age, early-weaned calves were heavier at slaughter, gained slower after 7 months of age but faster prior to 7 months, and had better feed efficiency. Carcass results showed early-weaned steers to have heavier carcasses, similar Yield Grades, and significantly higher marbling scores, with many more cattle grading high Choice and Prime.

The Bottom Line -- Early weaning (from 2 to 5 months of age) is a strategy to consider when cows are too thin or the feed situation is under pressure due to drought. High quality rations must be fed. If pasture is used, grain supplements must also be fed. When placed on high grain rations at this young age and fed to slaughter, finished weights are heavier, gains are more efficient, and carcass Quality grade is improved. Production costs are higher in intensively-fed early-weaned calves.

**Disclaimer: Mention of specific product names is not an endorsement of those products, but is included for information purposes only.**

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# Alternative Rations for Maintaining Pregnant Beef Cows

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**9/99** Drought situations leave many feeder calf producers with reduced stocks of homegrown hay. Losses of 40% to 70% of normal forage production are often reported. Under normal conditions, pregnant beef cows are fed hay during the winter to maintain them until they calve in the spring. A 1,000-pound pregnant beef cow requires a ration that contains about 8% crude protein (CP) and 54% total digestible nutrients (TDN). Timothy hay cut at the full-head growth stage, for example, contains 8.5% CP and 57% TDN.

Many alternative feedstuffs have been suggested to supplement reduced forage stocks. What follows are several rations that make use of some alternative feeds. These rations are designed to maintain a mature 1,000-pound pregnant beef cow, and each ration contains a minimum of 8.5% CP and 54% TDN. When drought conditions do not limit hay stocks, most brood cows consume about 16 pounds of grass hay plus small amounts of mineral and salt. The following rations would also require mineral and salt supplementation.

**Ration 1**

| INGREDIENT | POUNDS |
|---|---|
| Grass Hay | 4 |
| Corn Stover | 8 |
| Corn/Urea Mix* | 4 |
| Total | 16 |

*Corn/Urea Mix contains 3.9 pounds corn and .1 pound urea UREA

**Ration 2.**

| INGREDIENT | POUNDS |
|---|---|
| Grass Hay | 6 |
| Oat Straw | 6 |
| Corn/Urea Mix* | 4 |
| Total | 16 |

*Corn/Urea Mix contains 3.9 pounds corn and .1 pound urea UREA

**Ration 3.**

| INGREDIENT | POUNDS |
|---|---|
| Grass Hay | 6 |
| Oat Straw | 7 |
| Whole Cottonseed | 3 |
| Total | 16 |

**Ration 4.**

| INGREDIENT | POUNDS |
|---|---|
| Grass Hay | 4 |
| Soybean Hulls | 8 |
| Corn | 4 |
| Total | 16 |

Successful feeding of roughage extender and by-product feeds depends on proper ration balancing. Do not attempt to incorporate by-products or other alternative forage sources until you obtain a nutrient analysis from a laboratory. After obtaining this analysis, use proper ration balancing techniques to incorporate these feedstuffs into the overall ration. If you decide to use by-products, don't wait until your home-grown forage sources are exhausted before incorporating them into your rations. Again, they should be fed as a roughage extender, not as a total roughage replacement. For sources of analytical laboratories and ration balancing expertise, contact your county Extension office.

## Drought-stressed corn silage

Because of the drought, much corn silage is being harvested that contains few, if any, ears of corn. Nutrient analysis of this material shows a CP percentage that is higher and a TDN percentage that is lower than "normal" corn silage. Some lab analyses of "earless" corn silage have averaged 11% CP and 64% TDN. As a point of reference, "normal" corn silage is 8.5% CP and 70% TDN.

"Earless" corn silage can be supplemented with shelled corn to create a mixture that approximates the nutrient composition of "normal" corn silage. The supplementation should be at a rate of 80 parts "earless" corn silage to 20 parts shelled corn on a dry matter basis. For example, if your "earless" corn silage is 40% dry matter, then the as-fed rate of supplementation would be 10 parts "earless" corn silage to 1 part shelled corn.

It may not be necessary to supplement drought-stressed corn silage with shelled corn. Before making that decision, determine the nutrient requirements of the animals that are going to be fed the silage. If the "earless" corn silage provides enough energy to meet the animal’s needs, then supplementation is not necessary. Otherwise, as stated above, supplement at a ratio of 80/20 on a dry matter basis to provide an adequate forage.

# Body Condition Scoring Beef Cows

**Author: Dan E. Eversole, Extension Animal Scientist; Milyssa F. Browne, Graduate Student; John B. Hall, Extension Animal Scientist; and Richard E. Dietz, Graduate Student; Virginia Tech**
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**Overview**
Body condition scoring (BCS) is a useful management tool for distinguishing differences in nutritional needs of beef cows in the herd. This system uses a numeric score to estimate body energy reserves in the cow. Research indicates that there is a strong link between the body condition of a cow and her reproductive performance. The percentage of open cows, calving interval, and calf vigor at birth are all closely related to the body condition of cows both at calving and during the breeding season. All these factors play an important role in the economics of a beef cow-calf operation and help determine the percentage of viable calves each year. Monitoring body condition using the BCS system is an important managerial tool for assessing production efficiency.

**Body Condition Scoring System**

Body condition scores are excellent indicators of the nutritional status in beef cows. Ideal liveweight varies from cow to cow whereas ideal body condition (BCS 5-6) is the same for all cows. Also, body condition can be measured in the field without gathering or working cattle.

Body condition scores are numbers used to estimate energy reserves in the form of fat and muscle of beef cows. BCS ranges from 1 to 9, with a score of 1 being extremely thin and 9 being very obese. Areas such as the back, tail head, pins, hooks, ribs, and brisket of beef cattle can be used to determine BCS in Figure 1.

**Figure 1**

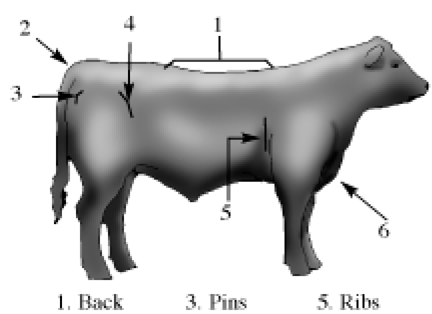



Figure 1. Areas useful for visually determining BCS in beef cows. Oklahoma State University

A cow in 'thin' condition (BCS 1-4) is angular and bony with minimal fat over the backbone, ribs, hooks, and pins. There is no visible fat around the tail head or brisket. A cow in 'ideal' condition (BCS 5-7) has a good overall appearance. A cow with a BCS of 5 has visible hips, although there is some fat over the hooks and pins and the backbone is no longer visible. Cows with BCS of 6 or 7 become fleshy and the ribs are no longer visible. There is also fat around the tail head and in the brisket. An over-conditioned cow (BCS 8-9) is smooth and boxy with bone structure hidden from sight or touch. She may have large protruding fat deposits (pones) around the tail head and on the pin bones. Be aware that gut fill due to rumen contents or pregnancy can change the appearance of moderately fleshy cows, especially over the ribs or in front of the hooks. Visual indicators of each BCS are listed in Table 1, and example photos of BCS 1-9 are illustrated in photos 1 through 9.

Long hair can often make it difficult to correctly evaluate the body condition score of a beef cow or heifer. When the hair on the cow is long, palpating the specific areas of fat deposition is particularly important, as shown in Figure 2. Cows should be palpated over the back, ribs, and over the horizontal processes of the backbone (edge of loin). 'Thin' cows will have a sharper feel in these areas than cows with moderate or fat body conditions.

**Figure 2**

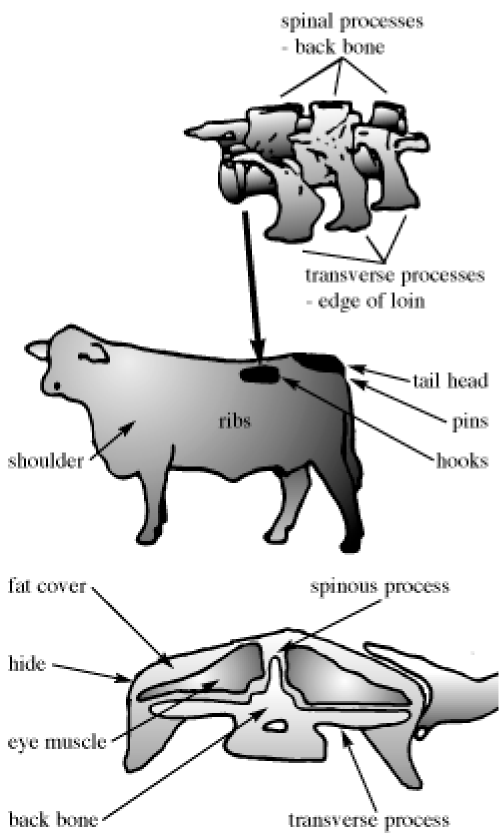



Figure 2. Specific anatomical areas used in determining BCS in beef cows.
Adapted from Herd and Sprott, 1986.

It is important to be aware that the breed of beef cow can have a strong influence on where body fat is deposited. For example, Bos taurus breeds and crossbreds will show a more uniform distribution of fat across the ribs, whereas Bos indicus cattle may have very little fat over the ribs but will deposit fat over the hooks and pin bones.

**Table 1. Reference table for body condition scores.**

| | Body Condition Scores | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Reference point** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Physically weak | yes | no | no | no | no | No | no | no | no |
| Muscle atrophy | yes | yes | slight | no | no | No | no | no | no |
| Outline of spine visible | yes | yes | yes | slight | no | No | no | no | no |
| Outline of ribs visible | all | all | all | 3-5 | 1-2 | 0 | 0 | 0 | 0 |
| Outline of hip & pin bones visible | yes | yes | yes | yes | yes | Yes | slight | no | no |
| Fat in brisket and flanks | no | no | no | no | no | Some | full | full | extreme |
| Fat udder & patchy fat around tail head | no | no | no | no | no | No | slight | yes | extreme |

(Modified from Pruitt, 1994.)

**Guidelines for Body Condition Scores**

On average, most beef cows score in the range of 3 to 7 throughout the year. A cow is expected to be in optimal body condition (BCS 5-7) before calving. She may lose condition after calving and possibly into the breeding season. She may gain condition and weight as weaning approaches (assuming there is adequate forage) and continue gaining fetal weight and any needed body condition in late gestation.

Body condition should be evaluated and recorded three times a year: at weaning, 60-90 days before calving, and at calving. By assigning BCS scores at the time of weaning, the cows can be sorted for appropriate feeding. Grouping cows by feed requirements and feeding them accordingly can help each of them reach BCS 5-7 by calving. Scoring cows 60-90 days before calving allows you to evaluate your dry cow nutritional program while allowing enough time prior to calving for "emergency feeding" if needed. Although body condition should be evaluated at calving, it may be difficult to increase body condition since lactation requires most of the energy a cow consumes. If environmental conditions at the time of calving are mild, cows may be able to reach BCS 5 or 6 by breeding time. However, this is unlikely to occur when the weather is cold or high quality feeds are limited.

Liveweight should not solely be used as an indicator of nutritional status of beef cows in a herd. Research indicates that body condition is a more reliable indicator of nutritional status than liveweight. Most herds have cows that range in age, frame size, and muscling all of which impact the weight of the animals. Therefore, only using liveweight may over- or under-estimate the amount of body fat. Liveweight is also affected greatly by gut fill and pregnancy. Weight and body condition will vary depending on the physiological state of the cow, forage quality and availability, and the body condition of the cow.

**Importance of Body Condition**

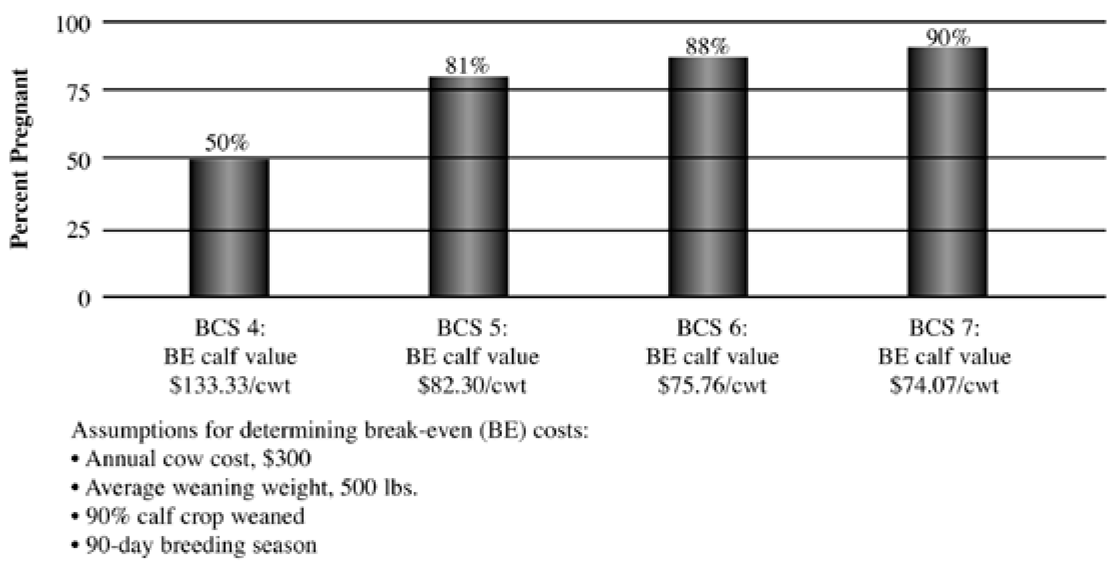
In order to manage a beef cow-calf operation in the most cost-efficient way, producers must be aware of the body condition of their herd. Research indicates that the body condition of beef cows is related to many critical aspects of production such as conception rate, days to estrus, calving interval, and milk production. When cows are extremely thin (BCS < 4), they are not only reproductively inefficient, but they are more susceptible to health problems. Cows at BCS 1 are in a life-threatening situation and need immediate attention. Cows that are over-conditioned (BCS 8-9) are the most costly to maintain. Two-year-olds with BCS 8-9 may encounter dystocia (calving difficulty) due to the excessive fat in the pelvic area. Table 2 lists many of the production problems associated with cows and heifers in 'thin' or 'fat' condition.

**Table 2. Problems associated with "thin" or "fat" body condition**

| Thin Condition BCS 1- 4 | Fat Condition BCS 8-9 |
|---|---|
| 1. Failure to cycle | 1. Costly to maintain |
| 2. Failure to conceive | 2. Increased dystocia |
| 3. Increased calving interval | 3. Impaired mobility |
| 4. Increased days to estrus | 4. Failure to cycle |
| 5. Decreased calf vigor | 5. Failure to conceive |

Failure to conceive is the most important factor contributing to the reduction of net calf crop. Conception rates are dramatically compromised in cows that are BCS 4 or less. Figure 3 shows the comparison between pregnancy rates and body condition scores and how these two factors impact the break-even cost of a cow-calf operation. In Virginia, the average yearly cost to maintain a cow is $300 per year. The following example also assumes an average weaning weight of 500 pounds and a 90% calf crop weaned. At a BCS of 4, only 50% of the cows were pregnant, resulting in a break-even cost of $133.33/cwt. At a BCS of 5, the 81% pregnancy rate results in a break-even cost of $82.30/cwt, at a BCS of 6 with 88% pregnant, the break-even cost falls to $75.76/cwt and finally, at a BCS of 7, the break-even cost falls to $74.07/cwt. Economically, BCS directly affects net calf crop and the success of a beef cow-calf operation. There is a significant difference in profit margin in percent calf crop between BCS 4 cows and BCS 7 cows.

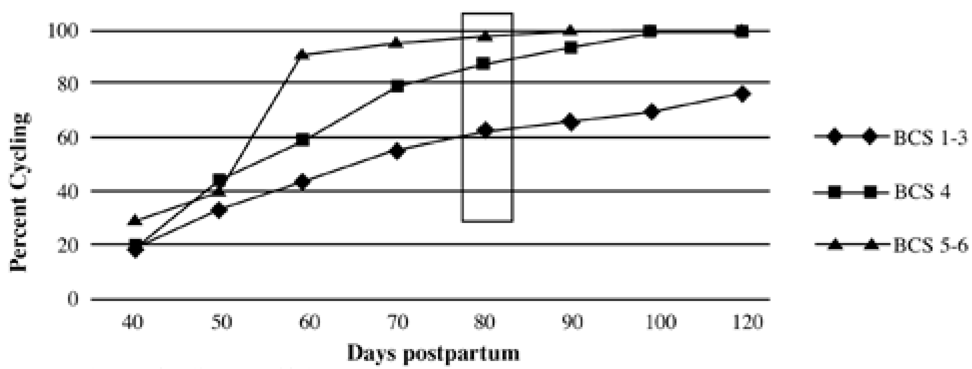
**Figure 3. Comparison of Pregnancy Rates and Body Condition Scores on Break-Even Costs in Beef Cows** (Modified from Selk et al., 1986. Oklahoma State University.)



Research indicates that the body condition of a cow influences days to first estrus after calving and calving interval. A beef cow must conceive within 82 days of the birth of her calf to maintain a 12-month calving interval. Figure 4 illustrates that 91% of the beef cows with BCS >5 at calving showed signs of estrus by 60 days post-calving, whereas only 61% of beef cows with BCS 4, and only 46% of beef cows with BCS <3 showed estrus. The percentage of cows cycling by 80 days postpartum is an important factor affecting calving interval. The rectangular box in Figure 4 shows the critical breeding time in order to achieve a 12-month calving interval. This figure demonstrates the differences in postpartum cyclicity for beef cows at different condition groups. Calving interval is a function of many aspects of reproduction including conception rate and percent cyclicity. If the cows are not cycling, they are not going to conceive, which lengthens the calving interval and negatively impacts profits.

**Figure 4**

**Figure 4. Effect of Body Condition at Calving and Subsequent Estrus**




(Adapted from Wiltbank, 1983.)

**Nutritional Programs Using Body Condition Scores**

Since feed costs make up roughly 60% of the cost of a cow-calf operation, different feeding programs can be used to achieve the best reproductive performance without high costs. Choosing a calving season that is most compatible with your forage program is the first step in maximizing cow condition and reproduction. Understand that the changes that occur in body weight and condition are normal in the production cycle of the cow.

**Table 3. Recommendations 90 to 100 days prepartum to achieve a BCS of 5 to 7 by calving.**

| Score | Desired Condition At Calving | Recommendations |
|---|---|---|
| 1 | 5 | Needs to gain in excess of 350 lb. Economics questionable. |
| 2 | 5 | Needs to gain 300 to 350 lb. Economics questionable. |
| 3 | 5 | Needs to gain 200 to 300 lb. |
| 4 | 5 | Needs to gain 150 to 200 lb. |
| 5 | 5-7 | Needs to gain weight of fetus and placenta 100 lb. |
| 6 | 5-7 | Needs to gain weight of fetus and assorted tissues 100 lb. |
| 7 | 5-7 | No weight gain needed. |
| 8 | 5-7 | Can probably lose 50 to 100 lb. |
| 9 | 5-7 | Can probably lose 100 to 200 lb. |

(Modified from Beverly, 1985.)

A medium-framed beef cow that is open will gain or lose approximately 75-100 pounds for each body condition score change. For example, a medium-framed beef cow with a BCS 5, weighing 1100 pounds, will be a BCS 3 and weigh approximately 900-950 pounds with a loss of 150-200 pounds and a decrease of two body condition scores.

Moreover, an additional 100 pounds is typically gained during the last trimester of gestation for fetal growth and uterine development. Table 3 shows body condition scores and weight change recommendations for cows achieving a desired BCS of 5-7 90 to 100 days before calving. This is the critical time when the producer has the ability to put condition back on a 'thin' cow or restrict feed intake of a 'fat' cow.

Maintaining and feeding beef cows to attain a BCS in the optimum moderate range (BCS 5-7) allow beef cows to achieve maximum reproductive performance while feed supplementation costs are held to a minimum. In most situations, it is not economically feasible to supplement the entire herd if only half of the cows will respond to the higher level of nutrition. Separating cows based on BCS and feeding them accordingly are good managerial strategies. This should be done at or soon after weaning to allow 2 to 5 months of feeding prior to calving.

**Summary**

Achieving a BCS of 5 or more before calving and throughout the production cycle is the key to a profitable cow-calf operation. Many producers waste profits by over-feeding cows in adequate condition when only part of the herd needs extra energy and supplementation. By sorting and feeding groups based on BCS, the economics of the operation improve. Producers need to pay attention to stocking rates and pasture quality. Overstocking and poor forage quality can lead to 'thin' cows.

As research indicates, monitoring cow condition directly impacts the reproductive performance of the herd. As mentioned above, failure to conceive is the most important factor in reducing net calf crop. Keeping cows in adequate condition throughout the production cycle can improve reproductive performance and positively impact the economics of the operation. The BCS system is relatively easy to learn and can be implemented in any farm situation. Please take the time to learn how to use this system and begin taking advantage of the benefits it has to offer. For help with the BCS system, contact your local Extension agent.

Photo 1: BCS 1. Emaciated with muscle atrophy and no detectable fat. Tail head and ribs project predominantly. Animal physically weak.

Photo 2: BCS 2. Poor condition with muscle atophy and no detectable fat. Tail head and ribs prominent.

Photo 3: BCS 3. Thin condition. Slight muscle atrophy. All ribs visible. Very little detectable fat.

Photo 4: BCS 4. Borderline condition. Outline of spine slightly visible. Outline of 3 to 5 ribs visible. Some fat over ribs and hips.

Photo 5: BCS 5. Moderate, good overall apperance. Outline of spine no longer visible. Outline of 1-2 ribs visible. Fat over hips but still visible.

Photo 6: BCS 6. High moderate condition. Ribs and spine no longer visible. Pressure applied to feel bone structure. Some fat in brisket and flanks.

Photo 7: BCS 7. Good, fleshy appearance. Hips slightly visible but ribs and spine not visible. Fat in brisket and flanks with slight udder and tail head fat.

Photo 8: BCS 8. Fat, fleshy and overconditioned. Bone structure not visible. Large patchy fat deposits over ribs, around tail head and brisket.

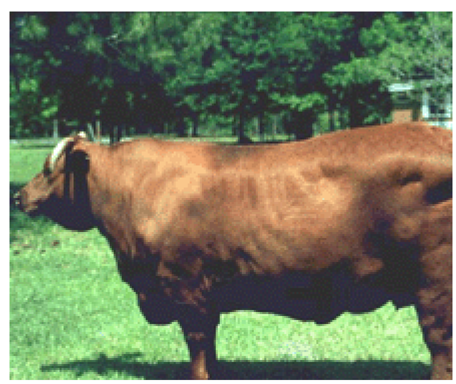


Photo 9: BCS 9. Extremely fat, wasty and patchy. Mobility possibly impaired. Bone structure not visible. Extreme fat deposits over ribs, around tail head and brisket.

# Tips on Managing Ewe Flocks with Reduced Feed Resources

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Drought situations place significant pressure on the feed and water resources available for livestock. Producers need to plan for the most effectively management and conservation of their resources. Early planning and decisions regarding the management of the livestock are most critical. Every operation may have different options based on stocking rates, production status of the animals, total available feed resources and the financial position and cash flow situation of the operation.

The following are some general management tips and guidelines that producers will find useful in their planning and decision making processes regarding the ewe flock.

1. Reduce number of animals and/or nutrient demands of the flock.

A. **Wean all lambs.** You have the options, depending on the average weight of these lambs, to either market them as feeder lambs or put them on feed for the slaughter lamb market. If you put the lambs on feed, you need to provide a ration that is 12-14% protein, add a coccidiostat (Deccox, 2 lbs/ ton of complete feed; 2 lb / 50 lb of mineral mix), deworm the lambs and vaccinate for overeating (C & D) 2-weeks prior to weaning. Maintain a deworming program as necessary.
B. **Cull all the nonproductive and lower producing ewes from the flock**. The remaining nonpregnant ewes will do fine on poorer quality pasture or low-quality hay until you get ready for breeding in the early fall. Monitor their body condition (2.5 is adequate). Do not allow the ewes to lose excessive body condition. A ewe at maintenance needs a dry matter intake of only about 2% of her body weight/day (a 150 lb ewe needs 3-4 lb of hay). If necessary, you can provide up to 1 lb of whole shelled corn or barley per head as a substitute for at least half of the hay. Deworm these ewes and maintain a deworming program as necessary until breeding. Do everything you can to limit hay feeding. Use racks, feed daily, provide adequate space for all ewes, and do not feed off the ground.

2. Fall breeding ewes.

If these drought conditions continue, you will need to flush these ewes for up to 16 days before the start of your breeding season (September-October). You can do this effectively with ¾ to 1 lb of whole shelled corn. You need to increase body condition score to 3.0 at breeding. Now is a good time to feed a free choice mineral mix.

3. Ewes due to lamb in October–December.

These ewes will do well on average quality hay before the last 4-6 weeks of pregnancy. Save the better quality hay supply to feed during these last 4-6 weeks of pregnancy and during the early lactation period. Again, it is important to monitor the body condition of these ewes and to maintain your deworming and vaccination programs.

During the last 4 weeks of gestation, you should begin to feed these ewes ½ to ¾ lb of concentrate (12 to 14 % protein) with 3-5 lbs of your better quality hay/head/day. If you do not feed a total mixed concentrate, you should be sure to offer a free choice mineral mix at this time. Be sure that you deworm the ewes prior to lambing. Following lambing, increase the amount of concentrate up to 1 lb for singles and 1 ½ lbs for twins. This means you need to separate the ewes at lambing for best management of feed resources. If feed resources continue to be limited, early-wean these lambs. The ewe produces 75% of her milk in the first 8 weeks of lactation. After that period, the ewe provides more companionship for the lamb than nutrition. You should consider creep feeding as a necessary component for the transition to total weaning. This helps ensure good rumen development and function of the lamb. Again, do not forget to give the lambs a booster vaccination for overeating disease at least 2-weeks prior to weaning.

4. Keep accurate records of feed and livestock inventories.

If federal or state disaster assistance becomes available in response to the drought, these records will be important when applying for assistance.

# Keep an Eye on Horse Health during Drought

West Virginia University
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**7/1999**

Drought conditions can take a terrible toll on horses, but observant owners can help mitigate the ill effects of the long, dry summer on their animals. Paul Lewis, a professor of animal and veterinary sciences in the West Virginia University College of Agriculture, Forestry and Consumer Sciences, offers the following suggestions to help horses beat the heat:

- If pasture grazing isn't available, replace it with hay. Concentrated feed isn't the best alternative to pasture, and it should not comprise more than 50% of the horse's diet. The horse must have a minimum of 1 pound of roughage per 100 pounds of body weight per day.
- Reserve the highest quality hay at your disposal for your youngest and oldest horses. Senior animals are less resistant to drought conditions, and their younger counterparts require more nutrients to grow. Monitor changes in weight loss or body condition score. Choose concentrates with higher levels of fat and protein for both younger and older horses.
- During a drought, the horse's daily dry feed intake (from hay, pasture, and concentrate) should be at least 1.5% of their body weight.
- Water intake is critical. The horse will need at least 1.5 to 2 quarts of water per pound of feed it consumes daily or approximately ½ gallon per 100 pounds of body weight. This is particularly true for active animals or animals in a high-temperature environment.
- Equally important is water quality. It should be high; water should be free of algae and microbial growth. If water looks discolored (blue-green, in particular), don't make the horse drink it.
- Active animals, or horses under training with a moderate level of intensity, require particular attention. Owners should monitor the animals' calcium, phosphorous, and mineral balance. Owners may also consider a feed with a fat level higher than 6% to help the animals maintain good health and increased energy density in the ration.
- Monitor noxious, opportunistic weeds in areas where horses might graze. These plants can thrive in drought conditions, and horses aren't as discerning as ruminants when it comes to plant matter. Pull weeds when possible, or isolate your animals from places where they grow.

# Seeding Supplemental Forages

# Growing Small Grains for Forage in Virginia Publication Number 424-006; Posted March 2005

**Authors: S. Ray Smith, Extension Specialist, Forages, Department of Crop and Soil Environmental Sciences; Brinkley Benson, Research Associate, Department of Horticulture; and Wade Thomason, Extension Specialist, Grains, Department of Crop and Soil Environmental Sciences; Virginia Tech**

**Introduction**

Cereal crops are used throughout the world for livestock feed. When they are managed properly they provide excellent grazing and high-quality silage or hay. It is important to remember that grazing should occur during the vegetative stage and silage or hay harvest should occur during flowering to early seed fill. Corn is one of the few annual crops that will provide quality forage after seed maturity. In fact, some ask why cereal crops are even considered for silage production given the high yields and high quality of corn. The following figure provides one answer to this question for Virginia where year-to-year variation in precipitation can have a huge impact on corn silage yield. Data presented is the yearly average corn silage yield for the commonwealth.

**Cereal Grains as Forages**

Cool-season cereal crops form the backbone of many farm enterprises in the United States, and Virginia is no exception. However, except for rye, Virginia producers make limited use of the tremendous forage potential provided by cereal crops. This publication provides an overview of the major cereals and how they can fit into a forage system.

**Wheat**

Wheat is one of the most versatile small grains for a farming operation. Due to its excellent winter hardiness, wheat can be sown later in the fall than barley and is a good choice for planting following a corn or soybean harvest. Wheat has good potential for pasture, silage, or hay production. Wheat will withstand wetter soils than barley or oats, but tends to be less tolerant of poorly drained soils than rye or triticale. It is not used as an all-purpose forage crop to the extent that it could be. Very short, semi-dwarf varieties have less forage yield potential than taller varieties. When grown for forage instead of grain, wheat should be planted earlier and at a higher seeding rate. Hessian fly and wheat streak mosaic can be greater concerns in early-planted wheat. Newer winter wheat varieties with Hessian fly resistance can be seeded (2 to 3 Bu/A) as early as late August and produce an abundance of excellent fall grazing. Early planting also increases the potential for recovery of residual or leftover nitrogen from the previous summer crop that might otherwise leach below the rooting zone during the winter months. Managed properly, wheat can be grazed in the fall, again in early spring, and finally harvested for hay or silage. As silage, wheat is of excellent quality and will normally produce more tonnage (6 to 10 T/A at 65 percent moisture) than barley (5 to 8 T/A) and be of higher quality than rye when cut at the bloom stage. At bloom stage, wheat yields are often 50 percent higher than at the boot stage with little loss in quality. For highest silage yields, the taller wheat varieties should be considered and not seeded until early to mid-October. Plant height may become a more important consideration than grain-yield potential when growing wheat for grazing, silage, or hay. However, if wheat is to be grazed and then used for grain production, grain-yield potential should be an important factor in variety selection. Another consideration in variety selection is the length and roughness of awns. Livestock tend to favor cultivars with small or no awns. Forage potential is greatly reduced when wheat is grown on soils with a pH of 5.5 or less.

**Barley**

Barley is generally more susceptible to winterkill than wheat, especially when it has been overgrazed. It should not be grazed as short or as late into the fall as wheat. Barley does best on fertile, well-drained soils, but is also well adapted to sandy soils. Barley is sensitive to acidic soil conditions and pH should be maintained at 5.5 or higher. Barley produces good-quality silage or hay, but because of lower tonnage, usually produces lower yields of total digestible nutrients per acre than the other small grains. Barley also has higher digestibility and lower cell-wall content, acid detergent fiber, and acid detergent lignin than the other small grains. For best forage yields, barley should be seeded in early to mid-September at 2 to 3 Bu/A and cut in the late softdough stage. Some varieties have barbed awns that can affect the palatability of hay, but other varieties have smooth awns. Barley yellow dwarf virus (BYDV), leaf rust, and smut can be serious problems for winter barley. Early planting tends to favor the occurrence of BYDV. Good-quality grazing can be obtained from early seeded barley, but it should not be grazed as close or as late in the fall as wheat or rye.

**Triticale**

The use of triticale as a forage crop is gaining popularity throughout the country and particularly in the Midwest. Triticale generally has a higher forage yield, but lower quality than wheat. Triticale is a cross between rye and wheat. As such, it is adapted to a range of soils and does well on sandy sites. Tolerance to low pH is better than wheat but not as good as rye. Although pure triticale will not contaminate adjacent wheat fields with rye, triticale seed is sometimes contaminated with rye seed.

**Rye**

Rye is the most cold tolerant and least exacting in its soil and moisture requirements of all the small-grain cereals. Like wheat, rye can be sown in late August at 2 to 3 Bu/A to provide fall grazing, excellent winter ground cover, and spring grazing. The rapid growth of rye, both in the fall and spring, makes it the most productive of the small grains for pasture. Rye is the earliest maturing small grain for silage with good quality when harvested at the proper stage of growth. Traditionally, rye has been a poor choice for silage because of its higher fiber content compared to wheat, oat, barley, and triticale and its palatability declines rapidly with maturity. The recent release of several ÒabruzziÓ types of rye (Winterking and Aroostook) has provided better varieties for grazing and silage. Recent trials indicate that these newer varieties of rye are able to maintain quality longer than triticale, but not as long as wheat. When grown for silage, rye should be seeded in early October (and until late November), harvested in the late-boot stage, wilted, and ensiled. Research has shown that at this growth stage rye protein is efficiently digested in the rumen with over 75 percent being utilized. Rye is a more consistent producer of spring pasture than wheat, although it quickly becomes stemmy and unpalatable in late spring.

**Winter Oats**

As a rule, the hardiest winter-oat variety (Kenoat) is considerably less winter hardy than common wheat and barley varieties. However, in the southern United States, winter oats will usually survive most winters and produce high yields of forage (4 to 8 T/A). Due to the lateness of maturity of most winter oat varieties, they are not well suited for double-cropping systems. However, the earlier maturing varieties of oat may be successfully used as silage when cut at the boot stage and wilted before ensiling. Similar to barley, winter oats must be seeded in mid-September at 2.5 to 3 Bu/A to be well established before cold weather arrives. Winter oats are best adapted to well-drained clay and sandy loam soils. They do not perform as well under extremely dry or wet conditions as do wheat or rye. Winter oats produce a high-quality silage; however, lower yields are common compared to the other small **grains.**

**Small Grains for Silage**

With limited acreage for growing row crops, a large percentage of small grain is being grown in a doublecropping system for an additional silage crop. Smallgrain silage also permits greater utilization of silage storage and feeding equipment. One of the most important decisions in producing high-quality small-grain silage is determining the stage of maturity at which to harvest. Several factors to be considered are: cropping system (double-cropping or only harvesting one crop per season);species and variety of small grain used; whether small grain is being used as a companion crop for grasses and legumes; and kind of livestock to be fed. In general, high-quality silage with good animal performance is obtained from small-grain silage cut at the head emergence stage. Data from the University of Georgia indicates that animal intake is higher for silage cut at early head emergence compared to the milk or dough stage. Daily milk production was about 15 pounds higher for cows fed small-grain silage cut at early heading.

The plant changes rapidly from head emergence to bloom as the stem stiffens. Fiber and lignin increase within the stem so the plant will be able to support the filled head. The vegetative ratio of leaf to stem goes down, and there is little nutrition in the head to offset this change. As the head fills, carbohydrate content goes up, which offsets some of the loss in quality due to greater fiber and lignin.

Small-grain silage cut prior to the soft-dough stage will be high in moisture and should be wilted to 35 percent dry matter. This will take one to six hours or more depending on drying conditions and stage of maturity. If equipment is not available to cut, wilt, and pick up from a windrow, then small grain should be allowed to reach the dough stage and direct chopped for acceptable silage. Direct-cut immature plants will cause seepage of silage, loss of nutrients, and acid silage, which is less palatable to animals and has an offensive odor. Small grains may become excessively dry if harvested when the grain is in the dough stage. In this case, water may need to be added or a high-moisture green chopped forage mixed with the small-grain forage.

Special attention should be given to the length of cut on small grain silage. Chopper knives should be kept sharp and adjusted for a 3/8- to 1/2-inch cut for good packing of the ensiled material. Long stems can be a direct channel for feeding oxygen into the silage, causing spoilage. The addition of 100 to 200 pounds of ground corn per ton of small-grain silage will improve the quality and feed value of silage. The use of a silage inoculant should be considered for late-summer seeded small grains chopped during late October. Cooler temperatures during this period may reduce ensiling bacteria populations needed to properly store silage. The beneficial use of silage inoculants for later cuttings during warmer weather has not been well documented. Small-grain silage can be stored in any upright or horizontal type silo, but packing is more difficult in the horizontal type silos. When filling horizontal silos, wheel tractors should be run continuously during filling to ensure adequate packing. A plastic cover held in place by a layer of sawdust, lime, or old tires should be used to seal the silo upon completion of filling. Smallgrain silage can also be made and stored as round bales with the use of bale-wrapper equipment.

**Liming and Fertilization**

High-quality small-grain forage production is most likely to occur where soil acidity has been corrected and a good fertilization program is followed. A soil test should be used to determine lime and fertilizer needs. In many cases, small-grain cover crops planted early for livestock forage benefit from carryover fertilizer applied to the previous summer annual. This practice makes valuable use of available plant nutrients that might otherwise be lost by leaching or surface runoff.

Nitrogen (N) increases vegetative growth and promotes tillering. Typical recommended N fertilizer rates for small-grain forage are 30 lb of N per acre in the fall and 30 lb topdressed in early spring. The amount of N needed will depend on the small grain species, soil type, crop use, previous crop, and planting date. When small grains are to be grazed, an additional 30 lb of N should be applied at seeding. A late-February to early- March application of 30 lb will stimulate tillering and early spring growth. Less nitrogen should be applied following tobacco or when N uptake from the previous summer annual was limited due to drought and/or poor plant growth. Split applications can help reduce lodging and the possibility of nitrate poisoning. In a total graze-out program, all the fertilizer can be applied preplant except on sandier soils or regular topdress applications can be made through the fall and early spring. If the crop is to be grazed until early spring then grown for grain, a split application is often best, with at least half the fertilizer applied preplant and the remainder topdressed after the cattle have been removed.

Phosphorus (P) stimulates rapid, early growth. If P is needed, it should be applied at or before seeding. Potassium (K) response in small grains has been less than for N or P. However, low levels of soil K should be corrected to aid standability and increase yield. Small grains harvested for silage remove large amounts of K from the soil, approximately 50 lb K2O/A. Therefore, fall-applied K should be based on the needs of the small-grain silage crop rather than the following summer annual crop.

**Seeding Rates:**
Wheat -- 120-150 lb/A or ~ 32-36 seeds/sq ft
Barley -- 120 lb/A or ~ 30 seeds/sq ft
Triticale -- 120-150 lb/A or ~ 32-36 seeds/sq ft
Rye -- 90-100 lb/A
Oats -- 65-80 lb/A or 25-30 seeds/sq ft
Increase seeding rates by 10 percent when planting no-tillage into heavy residue.

**Grazing Systems with Small Grains:**
As stated previously, each of the small grains furnishes excellent pasture in the fall and early spring. For early forage production, early seeding is necessary. In Kentucky, rye, oats, and triticale seeded on August 3 yielded 1.3, 1.4, and 1.4 tons more dry matter per acre, respectively, than that seeded on September 30. Wheat for forage is often planted four to six weeks earlier than wheat planted for grain production and at much greater risk of being severely damaged by the Hessian fly. Researchers in Georgia found that low to moderate levels of Hessian fly damage reduced spring forage yield 14 percent to 46 percent but did not greatly affect the crude protein or acid detergent fiber content. Therefore, varieties with Hessian fly resistance should be considered.

Fall grazing should be delayed until the plants are well established (6 to 8 inches high). Small-grain plants grazed before this time will likely suffer from severe defoliation and result in lower fall and spring production. On the other hand, excessive delay will result in rank, succulent plants, which are easily damaged during grazing. Stocking rate should be light enough to avoid continuous complete removal of top growth (graze to about 2 to 3 inches). Rotational grazing increases the production of small grains similar to that of perennial pasture grasses. Intermittent grazing should be timed to allow plants to fully recover (6 to 8 inches high) before the next grazing period. Research has shown that livestock trampling during grazing can sometimes have an influence on surface soil physical properties (decreasing infiltration rate and increasing bulk density); however, no significant reduction in productivity has been reported. It is likely that most soil surface changes arising from trampling are corrected by the freeze-thaw and shrink-swell action of winter.

**Wheat for Grazing and Grain:**
Stage of growth at the time of grazing and the length of the growing season remaining should be considered in managing wheat for both forage and grain. Wheat to be harvested for grain should not be grazed after the crop reaches the stem elongation stage and nodes begin to develop. At this stage, the spike (head) is above the soil surface and moving up the stem. Grazing after this stage can greatly reduce yields. Usually a plant will have about five to six leaves on the main shoot when internode elongation begins. To determine this stage, the stem can be sliced open lengthwise and the joint and developing head observed. Depending on seeding date and weather conditions, wheat may reach this growth stage by early to mid-March.

Research results are quite inconsistent in terms of grazing effects on grain yield of winter wheat. Grazing usually reduces grain yield of small grains (25 percent to 79 percent) although yield increases have been reported in Kansas, Texas, Oklahoma, Indiana, New Jersey, and Argentina.

Grazing of winter wheat can be used to good advantage under these conditions: when wheat is moderately grazed; when trampling losses are avoided; when abundant fall growth might lead to lodging or impeded regrowth in spring, and when severe weather conditions do not stress the crop beyond the levels of stress induced by grazing. An acre of small-grain pasture can carry approximately 500 pounds of live weight per acre.

Weaned calves can receive all their needed protein and energy from good small-grain pastures. The stocking rate can be increased when supplemental feeding is practiced. Several brood cows can be grazed per acre by allowing only one to two hours of grazing per day. Grazing should be managed to avoid continuous complete removal of top growth.

**Cereal Hay Production**
Small-grain cereals can be used as a hay crop, either as an **emergency** feed or as part of a planned early summer forage program. Yields often average 2 to 4 tons (air dry) per acre. The moisture content at baling should be about 15 percent to 20 percent for small, rectangular bales.

The quality of hay made from wheat, barley, oats, and rye at the late-boot stage is similar. Of the small-grain cereals, triticale hay is the most variable in quality. Hay quality is more dependent on stage of maturity at harvest than is silage quality. Small-grain hays will have the highest quality when harvested at the late-boot stage. A popular time to harvest small-grain cereals for hay is at the early-milk stage, however. This is the best compromise between highest dry-matter yield and maximum hay quality. If protein content is an overriding factor, the crop should be harvested at the late-boot stage. Dry matter yields are about 20 percent to 40 percent lower at this stage compared with the dough stage. Although the feeding value of small-grain hays is less than that of small-grain silages, hay can be excellent forage for young calves, replacement heifers, beef cows, and dry dairy cows. Rough awns in small-grain hay can cause cattle considerable soreness and irritation to the eyes, mouth, lips, gums, and lower surface of the tongue. A crop with rough awns should be ensiled rather than baled to minimize this occurrence. Also, harvesting at the late-boot stage rather than the dough stage reduces palatability problems caused by rough awns. Producers may want to consider planting awnless varieties of hard red winter and soft red winter wheat.

When harvesting small grains for hay in the late-boot stage, a crimper or crusher attachment will help speed the drying, but when harvesting in the milk or dough stages, these attachments increase kernel-shattering losses. If the crop is harvested in the dough stage, plants will not contain excess moisture, so crimping or crushing is seldom beneficial. Occasionally, nitrates accumulate in small-grain cereals. This tends to occur as a result of drought, hailstorms, or late frost. Nitrate accumulation in small grains is more of a concern with hay than with silage. Oat hay is more likely to have a high nitrate level than other small-grain cereal hays. Additionally, small-grain hays tend to be more slippery than alfalfa or native grass hays, and the bales will be more difficult to stack.

Hay or Silage with Small Grains?

Assuming the same stage of maturity, any quality differences between small-grain silage and small-grain hay are likely to be in favor of small-grain silage. Leaf loss and kernel shattering are important factors contributing to quality loss in more mature small-grain hay. Research in South Dakota showed 24 percent to 48 percent loss advantage for oat silage over oat hay. This difference included the effects of field losses, storage losses, waste during feeding, and differences in forage quality and animal use. In addition, the data showed 21 percent to 27 percent faster gains for oat silage over oat hay when each feed comprised the entire ration. Kansas State University researchers also indicate that wheat silage has 10 percent to 20 percent greater feed value than wheat hay. When substantial amounts of grain are fed, the difference in animal performance between silage and hay would be decreased.

Nitrate Potential

Nitrates can accumulate in potentially toxic amounts in small-grain forages. Circumstances that interrupt normal plant development (i.e., periods of cool cloudy weather, hail damage, frost, and drought) may contribute to high nitrate accumulation. Oat hay appears to accumulate more nitrates than other cereal hays. Small grain silages are less likely to contain dangerous levels of nitrates than hays made from the same crop since a 40 percent to 60 percent reduction of the nitrate level normally occurs during ensiling. Laboratory analysis for nitrate levels in a representative sample of hay should be considered if abnormal weather occurs just before hay harvest when hay is harvested at flowering or in earlier stages of growth. Toxic nitrate levels are very unlikely to occur in plants where growth conditions permit attainment of normal maturity and kernel development in hay harvested at the dough stage.

Nutritional considerations:

In general, small-grain forages are low in minerals; therefore, forage testing is highly recommended in order to provide livestock a properly balanced ration. Mineral supplements containing magnesium are usually necessary when grazing cattle on small grain pasture to minimize the occurrence of grass tetany. Small grain pastures can cause bloat. Daily supplementation with poloxalene (Bloat Guard) is highly effective in reducing bloat. Feeding high-quality grass hay, silage, and/or an ionophore such as Rumensin or Bovatec can also provide some protection against bloat. Rumensin and Bovatec have also been shown to increase stocker cattle weight gains on wheat pasture.

Summary

Small grains have the potential to provide supplemental nutrition to livestock as fall and spring pasture, as silage, and as a hay crop while serving as a winter cover, nurse crop, and/or scavenger of residual fertilizer nitrogen. Small grains managed for grain production should not be used as livestock forage unless the potential for lodging is considered high and total crop loss is likely.

UNIVERSITY OF MARYLAND EXTENSION
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# *Washington County Office*

## FALL SEEDED ANNUALS FOR FORAGE

**Compiled by: Jeff Semler, Extension Agent, Agriculture and Natural Resources**

### ***Annual Ryegrass***

- Annual ryegrass' ability to produce a vigorous seedling lends it to a variety of seeding methods into a number of forage cropping systems. A seeding rate of 30 pounds per acre has provided satisfactory results in numerous on-farm and research farm situations. It should be noted that annual ryegrass varieties will differ in seed size and density. This fact will require producers to adjust seeding rates and drill calibrations slightly from variety to variety.

- Some producers, particularly on dairy farms, utilize higher seeding rates of 40 or even 50 pounds. These increased seeding rates will produce more dense stands which can be used for either grazing or haylage harvest.

- Due to its small seed size, annual ryegrass seedings are either broadcast on the surface or no-tilled at ¼-inch depth. Under favorable conditions, germination can be expected in five to seven days.

- Annual ryegrass should not be seeded into living cool season grass stands. Ryegrass will not compete effectively with an established cool season perennial grass. However, in thin or poor perennial grass stands, annual ryegrass may be broadcast or no-tilled <u>after</u> the perennial grass is suppressed or destroyed with Gramoxone or Roundup.

- Annual ryegrass can be seeded into established alfalfa by broadcasting seed or no tilling. Seedings should be made immediately after the alfalfa cutting in late August or September.

- If the field to be seeded is cultivated by plowing or disking, the seedbed should be firmed. The seeding may then be made by broadcasting the seed alone or blended with dry fertilizer. The field should then be cultipacked. A conventional drill cannot be used to seed annual ryegrass in a cultivated field in a normal manner due to placing the seed too deep in the drill disk furrows. However, if the conventional drill is used in the raised position or if the boots are removed from the disc openers, the seed will be effectively broadcast. The field should then be cultipacked.

- In this area, many annual ryegrass seedings follow corn silage harvest. It is an effective cover crop. If no manure is to be applied, simply broadcast or no-till the seed. If applying manure with no incorporation, broadcast seed prior to manure application to improve soil contact. If manure is to be incorporated, follow recommendations for a cultivated field.

- Due to the prolific seed production of some ryegrass varieties, it should be noted that a number of producers have managed successful volunteer seedings in grazing situations, in alfalfa, and in annual ryegrass hay fields.

- Annual ryegrass responds vigorously to nitrogen (N) fertilization. Very satisfactory yields are obtained under intensive grazing or haylage harvest regimens using a total of 200lbs. of N. In very general terms, apply 50 lbs. N at the early September seeding. Then in the spring, apply 50 lbs. N on April 1, May 1, and June 1 for maximum growth. Manure can provide a portion of this N requirement.

- Fall seedings made before October can utilize up to 50 lbs. of N to produce a fall crop to be grazed or cut for haylage by mid to late November. Later seedings will utilize proportionately less N.

- Excessive fall growth should be harvested or clipped to a 3-4 inch height to prevent matting under snow. Due to the continuous growth habit of annual ryegrass leaves and lack of true dormancy, matting or excessive freeze damage to grass leaves will delay or inhibit spring growth.

- Under a haylage system, the best forage quality is achieved when the first cutting is harvested when the plants are in the late vegetative to early boot stage of maturity. This corresponds to an average height of 15-20 inches. Immediately apply 50 lbs. of N and plan to harvest the next cutting in 20 days. Each producer will then need to decide how long to graze or cut haylage from the ryegrass before replanting the field to the next crop in a double crop system.

- Care needs to be taken in controlling ryegrass regrowth prior to planting the next crop. Annual ryegrass regrowth is more difficult to control than that of cereal rye. Producers have obtained good results by allowing several inches of regrowth and using Roundup at a 1½-quart rate. Post-applied grass herbicides provide effective control also.

- Annual ryegrass is an aggressive and versatile forage grass, but its real value is in its ability to produce significant yields of high quality forage. This ryegrass can be harvested as pasture, greenchop, chopped haylage, baleage or dry hay. Optimum forage quality will be obtained only by heads-up forage management.

- Ryegrass needs to be grazed <u>before</u> the grass begins the jointing phase of development. Ryegrass is best managed under a management intensive grazing system. Initiate grazing when the grass is six inches tall and move animals quickly. Expect to maintain a 10-12 day rotation to achieve top forage quality. The key is to keep the grass in a vegetative growth state as long as possible.

**NOTE!! Do not use annual ryegrass in grain production systems!** It is a prolific seed producer and is a serious weed in small grains!

***<u>Barley, Triticale, Rye</u>***

- Seed mid-August to late October. Rates 2-3 bu/A. Higher rate is better. Remember the purpose is forage, not grain. Rye is different. It can be seeded up to January, germinate in March and still make a harvestable crop.

- Well-fertilized late summer seedings and a moist fall can make 12-15 inches of vegetative growth by Thanksgiving. Can do some mechanical November harvest, but usually graze down to three inches. Grazing forage quality is excellent into January, then declines slowly through late winter. Fall growth can use 50-75 lbs. N (or manure equivalent). Apply N (or manure) again in late March to early April for spring growth. Spring growth can be grazed or chopped at boot stage; rye--May 1; triticale--May 10; barley--May 15 (more or less).

***Wheat***

- Same as above except do not seed before September 15-October 1. Wheat needs to emerge after Hessian fly free date. Yes, they are still here!

***Spring Oats***

- Seed mid-August to late September at a rate of 2½-3 bu. Seedings emerged by September 10-15 will start to come into head by November 15-20. Can be chopped to fill silo, made into round bale haylage or grazed. If grazing is the option, can begin at six inches of growth. Flash graze paddock by paddock. Oats will stop growing when ground begins to freeze. Quality will hold until after several very hard freezes (20 degrees F or less) then decline slowly. Oats will die over the winter; no spring regrowth.

- May be seeded with winter peas for more protein. Chop for silage in mid to late November.

- May be seeded with rye. Two bushels of each. This gives a good fall harvest and a spring harvest.

- Can be seeded with annual ryegrass, too--2-3 bu. Oats and 25-30 lbs. Ryegrass. Chop or graze by Thanksgiving and continue ryegrass harvest in the spring.

**Brassicas**

Brassicas (turnips, radishes, rape) can be planted at different times of the year and with various companion crops. The purpose of this chart is to provide some options on how turnips may be used for different seasons, different animals, and different uses.

| **Brassicas** | **Planting rate #/Ac** | **Benefits** | **When to plant** |
|---|---|---|---|
| **Appin Forage Grazing Turnip** | **2-5** | **Multiple grazings, multiple uses for Beef, Dairy, and Sheep** | **Spring, Summer, Fall** |
| Purple Top Turnip | 2-5 | Some grazing, good bulb yield, good for sheep | Spring, Summer, Fall |
| Tankard Turnip | 2-5 | Some grazing, excellent bulb yield | Summer, Fall |
| Tillage Radishes | | | |
| **Spring Planting Companion crops** | | | |
| Annual Ryegrass | 30-40 | Vigorous growth, excellent quality and palatability thru mid-Summer | Early March-thru April |
| Oats | 3-4 bushels | Vigorous growth thru mid-Summer | Early March |
| **Summer Planting Companion crops** | | | |
| Annual Ryegrass | 30-40 | | Mid-August after wheat is harvested |
| BMR Sorghum-Sudangrass | 30 | Excellent palatability and animal production, **Appin Turnips** re-grow with sorghum-sudangrass | Sow when planting sorghum-sudangrass |
| Corn | | Graze corn with Turnips or harvest corn and graze turnips and stover after harvest | Arial seed turnips into standing corn in late-August |
| **Late-Summer Planting Companion crops** | | | |
| Oats with Cereal Rye | 1-Bu. Each with 5# Turnips | Oats provide fall growth with turnips while Cereal Rye provides spring growth | Arial seed turnips Aug 20-30 into standing corn or after corn silage is harvested |
| Annual Ryegrass | 30-40# with 5# Turnips | Annual ryegrass provide excellent fall growth and spring growth is likely in many areas | Arial seed turnips Aug 20-30 into standing corn or after corn silage is harvested |

** **Remember—fall forage growth still depends upon rainfall! But if good moisture is present by September 1st--go for it! And do not forget to apply N to any grass pastures or grass hay fields that can be pastured October-December. All animals including dry cows and dairy heifers do okay on fescue over the winter!**

**For farm specific questions, contact your county's Extension Agent or Crops Consultant.**

# *Appendix*

# Certified Forage Testing Laboratories for Maryland

**By Les Vough, Forage Crops Extension Specialist**

Laboratory analyses are important for the evaluation of nutritive value in forages. Hay growers and livestock owners are encouraged to use forage testing as a management tool to improve forage production practices and feed efficiency. But how do you know which laboratories provide accurate and reliable results?

The National Forage Testing Association (NFTA) was founded in 1984 not only to address this question but to also improve the accuracy of forage testing among laboratories. The mission of the NFTA is to improve the accuracy and reproducibility of laboratory analyses that are important for the evaluation of nutritive value in forages. Accuracy can only be determined by comparing results to a reference value that can be defined unambiguously. The NFTA uses a certification testing (check sample) program to provide an unbiased assessment of the accuracy and reproducibility among participating laboratories. Proficiency is measured on check sample results of dry matter, crude protein, acid detergent fiber, and neutral detergent fiber.

NFTA is a joint effort of the American Forage and Grassland Council (AFAC), the National Hay Association (NHA), and forage testing laboratories. It is governed by a 12-member board of directors. Six directors represent laboratories, three represent AFGC, and three represent NHA.

Since its formation, reproducibility of lab results among laboratories has dramatically improved. Various lab methods have been reviewed and improved. Over 150 laboratories annually participate in the certification process. Laboratories are evaluated six times a year. Performance grades are provided to laboratories to allow them to better evaluate their testing procedures and methods. The NFTA certified laboratories have proven the ability to produce accurate test results on recognized reference methods.

The following laboratories in Maryland, Pennsylvania, and Ohio have completed the NFTA certification test and are certified for the year 2003: (Note: No laboratories in New York or Virginia are on the 2003 certified list.)

**Lab & Contact Address**

**Brookside Laboratories, Inc.**
Greg Meyer (419) 753-2448
308 S. Main St.
Knoxville, OH 45871
Website: http://www.blinc.com/feeds.htm

**Cumberland Valley Analytical Services**
Sharon Weaver (301) 790-1980
14515 Industry Dr.
Hagerstown, MD 21742
Website: http://www.foragelab.com

**Dairy Tech Labs**
Jesse Sanders (717) 295-8748
805 Rohrerstown Rd.
Lancaster, PA 17601
Website: http://www.dairyconsultantlink.com/dairytech/index.cfm
The complete list of certified labs can be found at http://www.foragetesting.org.

# Drought Related URLs

West Virginia University
Extension Service

## Hay Sources

Maryland:
http://www.mda.state.md.us/md_products/hay_straw_dir/index.php

Hay Exchange:
http://www.hayexchange.com/

Michigan Extension Service Hay Listing Network
http://web2.canr.msu.edu/hay/

## University of Maryland Resources

Maryland Forages Page
http://www.mdforages.umd.edu/

Small Grains for Fall and Spring Forage
http://www.psla.umd.edu/extension/publications/foragefacetsno6.html

Cover Crops, Small Grains and Crop Residue Provide Fall/Winter
http://www.psla.umd.edu/extension/publications/foragefacetsno7.html

Seeding Small-Acreage Horse Pastures
http://www.psla.umd.edu/extension//publications/Seeding_Small-Acreage_Horse_Pastures.pdf

Listing of Horse Pasture Fact Sheets:
http://www.mdforages.umd.edu/publ.cfm

Annual Ryegrass Variety Trial fromVirginia
http://www.vaes.org.vt.edu/SPAREC/Annual-Ryegrass-Trial-2001.PDF

## West Virginia University Resources

Small Grains as Forage Crops
http://www.wvu.edu/~agexten/pubnwsltr/TRIM/5192.htm (10-95) (PDF) - 5192

Recommended seeding rates of forage species when seeded alone or in mixtures.
http://www.wvu.edu/~agexten/pubnwsltr/TRIM/5302.htm - (94) (PDF) - 5302

Combining forage species in a seeding mixture
http://ww.wvu.edu/~agexten/pubnwsltr/TRIM/5304.htm (93) (PDF) 5304

Frost and walk-in clover seedings
http://www.wvu.edu/~agexten/pubnwsltr/TRIM/5312.pdf - (95) PDF Format - 5312

No-till seedings
http://www.wvu.edu/~agexten/pubnwsltr/TRIM/5314.htm (97) (PDF) - 5314

Walk-in seedings
http://ww.wvu.edu/~agexten/pubnwsltr/TRIM/5315.htm (PDF) - 5315

1998 Annual Ryegrass Performance in Western Maryland Demonstration Report
http://www.wvu.edu/~agexten/pubnwsltr/TRIM/5187.htm - (PDF) - 5187

1998 Marshall Annual Ryegrass Demonstration
http://www.wvu.edu/~agexten/pubnwsltr/TRIM/5194.htm - (PDF) - 5194.6

## Other On-line Resources

National Drought Mitigation Center - University of Nebraska-Lincoln
http://drought.unl.edu/

National Drought Monitor - University of Nebraska-Lincoln
http://drought.unl.edu/dm/monitor.html

Farm Service Agency - USDA
http://www.fsa.usda.gov/FSA/webapp?area=home&subject=diap&topic=landing

Small Business Administration Disaster Loans
http://www.sba.gov/services/disasterassistance/index.html

Agricultural Disaster Drought and Water News
http://www.disastercenter.com/drought.htm

Small Grains Management - Penn State University
http://fcn.agronomy.psu.edu/fcn998.html

Agronomy Publications - Penn State University
http://cropsoil.psu.edu/resources/publications.cfm

Annual Rye Publication - Oregon State University:
http://extension.oregonstate.edu/catalog/html/pnw/pnw501/

Small Grains for Silage or Hay - University of Nebraska-Lincoln
http://www.ianr.unl.edu/pubs/beef/g696.htm

Drought Mitigation for Agricultural Producers - University of Nebraska-Lincoln
http://drought.unl.edu/mitigate/ag_tools.htm

Drought Information - Oklahoma State University
http://www.okstate.edu/ag/oces/timely/drought.htm

Drought Information Factsheets including Farm Family Stress Tax Implications - North Carolina State University
http://www.ces.ncsu.edu/disaster/drought/

Harvest Droughty Corn for Grain or Sell It for Silage - North Carolina State University
http://www.ces.ncsu.edu/disaster/drought/dro-11.html

**UME-Alleghany County**
**One Commerce Drive**
**Cumberland, MD 21502**
**301-724-3320**
**Fax: 301-722-4015**

**UME-Anne Arundel County**
**Government Office Bldg.**
**7320 Ritchie Hwy., Suite 210**
**Glen Bernie, MD 21061**
**410-222-6759**
**Fax: 410-222-6747**

**UME-Baltimore City**
**6615 Reistertown Road, Suite 201**
**Baltimore, MD 21215**
**410-856-1850**
**Fax: 410-856-1852**

**UME-Baltimore County**
**1114 Shawan Road**
**Cockeysville, MD 21030**
**410-771-1761**
**Fax: 410-785-5950**

**UME-Calvert County**
**County Svcs. Plaza, Suite 300**
**30 Duke St., Rm 103, P. O. Box 486**
**Prince Frederick, MD 20678**
**410-535-3662**
**410-535-2438**

**UME-Caroline County**
**207 S. Third Street**
**Denton, MD 21629**
**410-479-4030**
**Fax: 410-479-4042**

**UME-Carroll County**
**700 Agriculture Center**
**Westminster, MD 21157**
**410-386-2760**
**Toll free: 888-326-9645**
**Fax: 410-876-0132**

**UME-Cecil County**
**County Adm. Bldg. Suite 1500**
**200 Chesapeake Blvd.**
**Elkton, MD 21921**
**410-996-5280**
**Fax: 410-996-5285**

**UME-Charles County**
**9375 Chesapeake St., Suite 119**
**LaPlata, MD 20646**
**301-934-5403**
**DC Area 301-753-8195**
**Fax: 301-753-1857**

**UME-Dorchester County**
**P. O. Box 299, Co. Bldg., 501 Court Lane**
**Cambridge, MD 21613-0299**
**410-228-8800**
**Fax: 410-228-3868**

**UME-Frederick County**
**330 Montevue Lane**
**Frederick, MD 21702**
**301-600-1594**
**Fax: 301-600-1588**

**UME-Garrett County**
**1916 Maryland Hwy., Suite A**
**Mt. Lake Park, MD 21550**
**301-334-6960**
**Fax: 301-334-6961**

**UME-Harford County**
**P. O. Box 663**
**2335 Rock Spring Road**
**Forest Hill, MD 21050**
**410-638-3255**
**Fax: 410-638-3053**

**UME-Howard County**
**3300 N. Ridge Rd., Suite 240**
**Ellicott City, MD 21043**
**410-313-2707**
**DC Area 301-621-4300 x410**
**Fax: 410-313-2712**

**UME-Kent County**
**Kent Co. Public Works Complex**
**709 Morgnec Road, Suite 202**
**Chestertown, MD 21620**
**410-778-1661**
**Fax: 410-778-9075**

**UME-Montgomery County**
**18410 Muncaster Road**
**Derwood, MD 20855**
**301-590-9638**
**Fax: 301-590-2828**

**UME-Prince Georges County**
**6707 Groveton Drive**
**Clinton, MD 20735**
**301-868-9366**
**Fax: 301-599-6714**

**UME-Queen Anne's County**
**505 Railroad Avenue, Suite 4**
**Centreville, MD 21617-1138**
**410-758-0166**
**Fax: 410-758-3687**

**UME-St. Mary's County**
**P. O. Box 663**
**21580 Peabody Street**
**Leonardtown, MD 20650**
**301-475-4484**
**Fax: 301-475-4483**

**UME-Somerset County**
**30730 Park Drive**
**Princess Anne, MD 21853**
**410-651-1350**
**Fax: 410-651-0806**

**Talbot Agriculture Svc. Center**
**28577 Mary's Court, Suite 1**
**Easton, Maryland 21601**
**410-822-1244**
**Fax: 410-822-5627**

**UME-Washington County**
**7303 Sharpsburg Pike**
**Boonsboro, MD 21713**
**301-791-1304**
**Fax: 301-791-1048**

**UME-Wicomico County**
**P. O. Box 1836**
**28647 Old Quantico Road**
**Salisbury, MD 21802-1836**
**410-749-6141**
**Fax: 410-548-5126**

**UME-Worchester County**
**P. O. Box 219, 100 River Street**
**Snow Hill, MD 21863**
**410-632-1972**
**Fax: 410-632-3023**