8-16-2010

2010 Drought Management Handbook

Craig W. Yohn
West Virginia University

Extension Service
West Virginia University

2010 Drought Management Handbook

Compiled by
Craig W. Yohn
WVU Extension Agent – Jefferson County

You Can Count On Us!

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West Virginia University
Extension Service

August 16, 2010

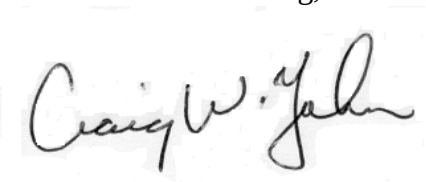
In response to the drought of 2010 this Drought Management Handbook has been revised from the 2007 drought handbook developed.

I used many sources of information on how you can manage your livestock farming operation. Corn silage will be plentiful, but it brings hazards and may not be the best value for feeding your livestock. There are several articles and references that discuss alternative feeds. Hay will be expensive and in short supply. There are several articles on alternative feeds. Please review and make a sound and thoughtful decision about managing your operation.

If you have any further questions or comments, or would like to order a copy of the Handbook you may contact me at the Jefferson County Extension Office of the West Virginia University Extension Service at: 304.728.7413, ext. 2 or email me at craig.yohn@mail.wvu.edu.

I would also like to take this opportunity to thank Dr. Ed Rayburn for reviewing the contents of this handbook and all of the land grant universities that had articles I could use to develop this handbook.

Yours for better farming,



Craig W. Yohn
Extension Agent – Jefferson County

U.S. Drought Monitor

West Virginia

August 10, 2010
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	77.2	22.8	11.2	5.1	0.0	0.0
Last Week (08/03/2010 map)	77.2	22.8	11.2	5.1	0.0	0.0
3 Months Ago (05/18/2010 map)	96.3	3.7	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)	57.5	42.5	18.5	0.0	0.0	0.0
One Year Ago (08/11/2009 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

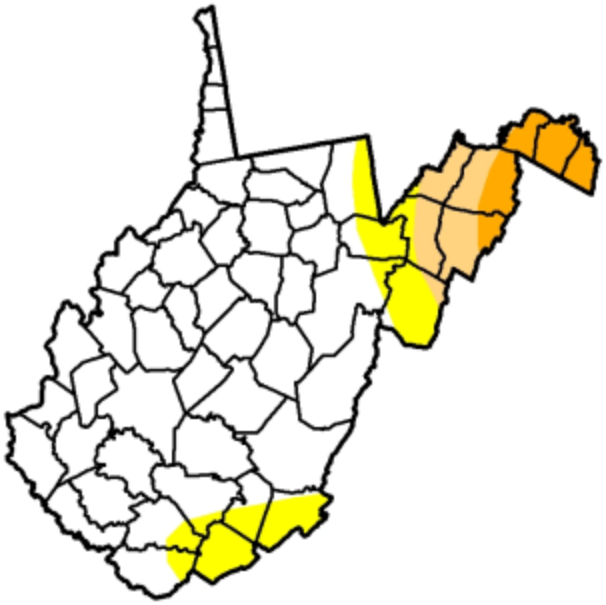


Table of Contents

Feed Related Information

Managing Drought-Stressed Corn for Silage [1]

Charles R. Staples[2]

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.

2. Charles R. Staples, Assistant Professor of Dairy Science, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611.

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.

WHERE TO SUBMIT CORN SILAGE SAMPLES FOR NITRATE TESTING: North Carolina Plant Testing Services: For more information consult your regional North Carolina Department of Agriculture agronomist or visit the website at: www.ncagr.com/agronomi/problem.htm

Determining the Value of Drought-Stressed Corn

University of Maryland Fact Sheet 483

Lester R. Vough, Extension forage crops specialist – University of Maryland -Department of Agronomy
Stanley W. Fultz, Extension agent, dairy science - Frederick County
E. Kim Cassel, Department of Dairy Sciences- South Dakota State University

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	60
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.

Substituting Grain for Hay

West Virginia University
Extension Service

Stephen Boyle
Beef Specialist
OSU Extension Service
7/99

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.

Alternative Feeds Extends Limited Supplies

W. L. Shockey
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WVU Extension Service, Preston County
10/1999

1. **Corn Stalks** that are clean and well cured can be baled and fed with proper supplementation. They are low in protein, energy, vitamins, and minerals and high in fiber.
2. **Straw**, like corn stalks, is low in protein, energy, vitamins, and minerals. It can be used to extend your forage supply when maintaining pregnant livestock or other animals that are not in a high state of production.
3. **Winter wheat, rye, and triticale** can provide additional forage in late fall and early spring, especially in warmer regions of the state. They possibly may provide silage for next summer.
4. **Sudangrass and sorghum-sudangrass hybrids** can be used to supplement pastures or stored as silage. These crops are usually difficult to dry for good-quality hay preservation because they have very coarse stems.
5. **Pearl millet** is a warm-season grass that can be used to obtain an emergency forage crop in midsummer. It has been shown to substitute well for corn silage in the diet of lactating dairy cows.
6. **Soybeans** also can be used as an alternative forage. Soybeans probably are best preserved as wilted silage. Direct-cut silage is too wet to produce a good fermentation, and hay can cause excessive leaf loss.

7. **By-product feeds** include brewers grains, corn gluten feed, wheat bran, soybean hulls, whole cottonseed, cottonseed hulls, beat pulp, wheat middlings, sunflower meal, and many others. Typically, they are higher in fiber and lower in starch than grains and oilseeds.

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 an analytical laboratory. After obtaining a nutrient analysis, use proper ration balancing techniques to incorporate these feedstuffs into the 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. They should be fed as a roughage extender, not a total roughage replacement. Sources of analytical laboratories and ration balancing expertise can be obtained from your county Extension office.

Following is a table of some common by-products and recommended maximum feeding rates.

Feed	Maximum lb/head/day
Beet pulp	5
Brewers grain, wet	40
Whole cottonseed	7
Corn, ear	35
Corn gluten feed, dry	15
Oat hulls	5
Soyhulls	10
Wheat bran	8
Wheat midds	8
Alfalfa pellets	10
Corn gluten meal	4
Sunflower meal	5

Feeding Straw

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

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
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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

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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 lbs	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.
Bermudagrass hay	✓	✓	1.0 lb	1.2 lbs	Type of grass hay imported from southern U.S.; hay Similar nutrition as other gra□s hays.
Millet hay	✓	✓	1.3 lbs	1.6 lbs	Usually contains some millet grain; Less nutritional value than most grass hays; May have a laxative effect if feed as the only roughage.
Sorghum grass	Not recommended				Includes Johnsongrass, 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; Similar nutrition as alfalfa hay (see above).
Alfalfa/timothy hay cubes	✓	✓	0.95 lbs	1.1 lb	Combination of alfalfa and timothy forages; Less protein and calcium than straight alfalfa, but more than plain timothy.
"dehy" alfalfa pellets	✓	✓	0.85 lbs	1.0 lb	Pelleted alfalfa hay; Similar nutrition as alfalfa (see above).
"Complete" feed	✓	✓	0.70 lbs	0.85 lbs	Contains a mixture of grains and roughage sources; Designed to be fed without hay; Should contain at least 15% fiber if no hay is fed.
Haylage	✓	✓	1.55 lbs	1.85 lbs	Hay preserved by ensiling rather than traditional drying; Higher moisture than hay, so will have to fe□d 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.
Straw	✓	✓	1.25 lbs	1.5 lbs	Oat straw more palatable than wheat or barley straw; Bulky, high fiber, low in other nutri□nts; Will require protein supplementation.
Beet Pulp	✓	✓	0.70 lbs	0.85 lbs	Good source highly digestible fiber; Relatively high in calcium; May require soaking before feeding; Limit to 10 lbs (dry weight) or less.
Soy hulls	✓	✓	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 phosphorus; 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; Can 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 as 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.

Drought and the Animal

Drought Management Strategies for Beef Cattle

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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.

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J. Scott Angle, Dean and Director

Feeding Strategies During Drought

Dr. Mark L. Wahlberg, Extension Animal Scientist

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.

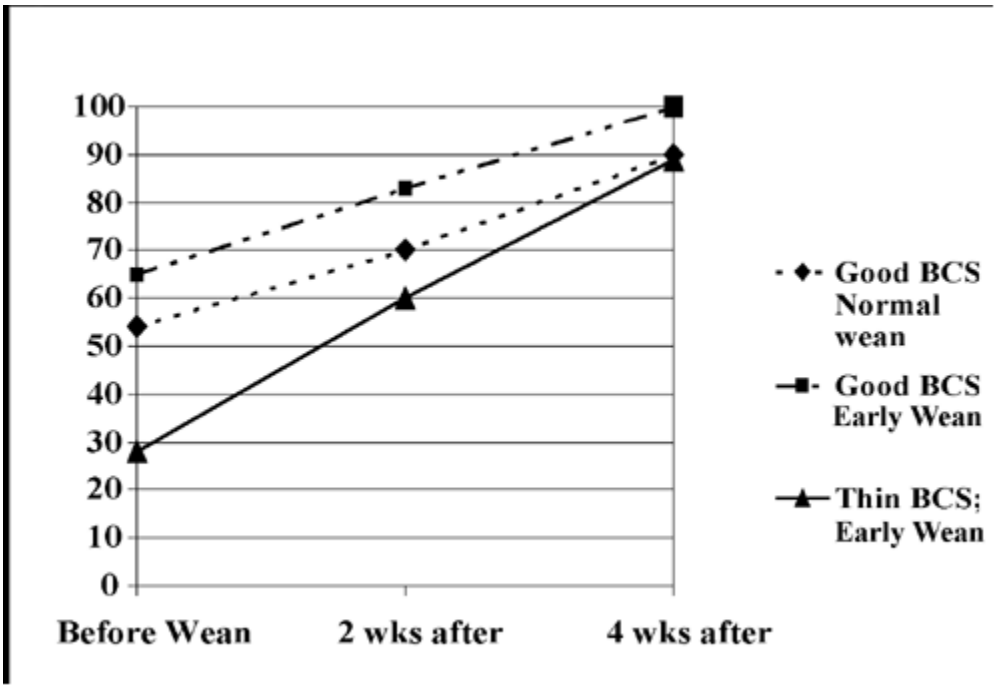
Table 1. Some examples of diets for 1200 lb cows with good milking ability Hay in the following table is 50% TDN and 10 % Crude protein and $40/ton.

Production stage	Diet	Cost
Dry cow, middle trimester of pregnancy	26 lbs. hay + free choice mineral 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 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 OR	$ 1.19/day
	16.5 lbs hay + 13.5 corn + 2.2 lbs soybean meal and free choice mineral 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.

Creep Feeding 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.

Early Weaning Health Concerns -- 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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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

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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

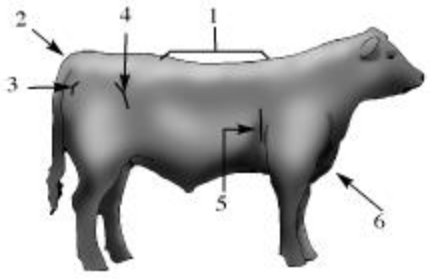


Figure 1. Areas useful for visually determining BCS in beef cows. Oklahoma State University

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

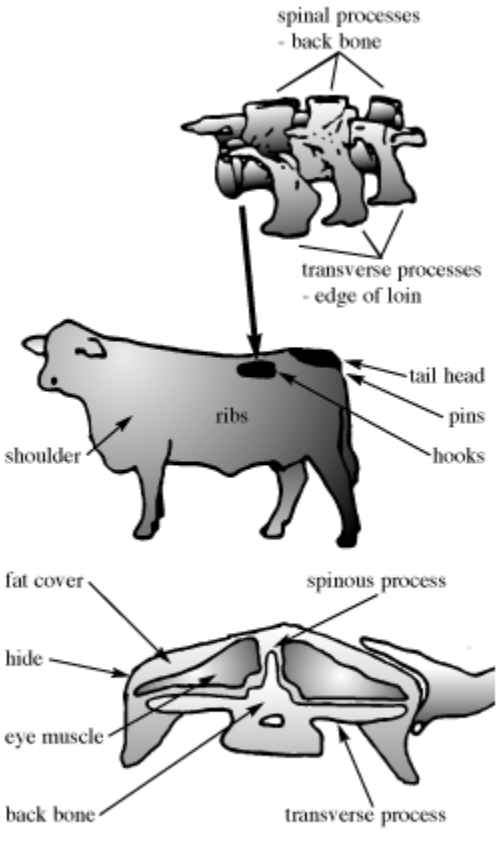


Figure 2. Specific anatomical areas used in determining BCS in beef cows.
Adapted from Herd and Sprott, 1986.

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.

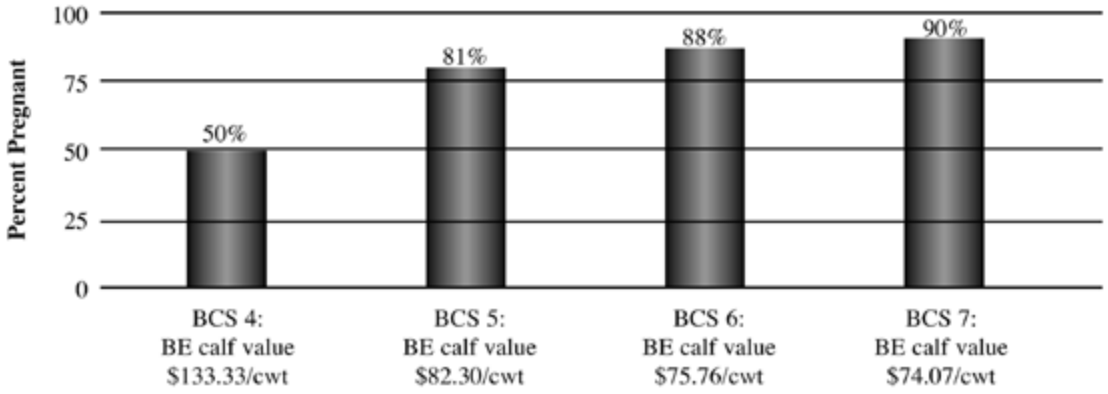
Table 2. Problems associated with "thin" or "fat" body condition

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

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.)

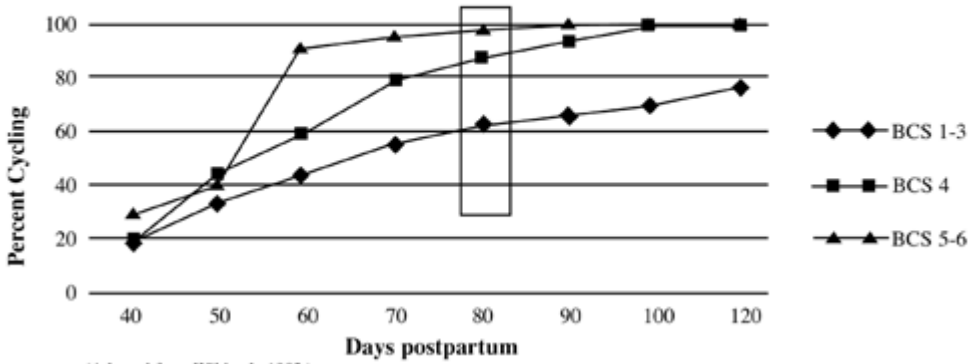


Assumptions for determining break-even (BE) costs:
- Annual cow cost, $300
- Average weaning weight, 500 lbs.
- 90% calf crop weaned
- 90-day breeding season

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

West Virginia University
Extension Service

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7/00

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
Extension Service

David Welsh
WVU Davis College of Agriculture, Forestry and Consumer Sciences
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.

Appendix

Alternative Feed Sources

The West Virginia Extension Service makes no endorsement of any of the businesses listed below. They have all been contacted to verify that they do carry any or all of the alternative feeds mentioned in the facts sheets in this handbook.

CFC Farm and Home Center
Culpeper, VA
540.825.2200

Coors Brewery
Elkton, VA
717.729.7151

Farmers Cooperative Association
Frederick, Maryland
301.663.3113

Martins Elevator
Hagerstown, MD
301.733.2553

Paramount Feed and Supply
Hagerstown, MD
301.733.8150

Southern States Cooperative
Charles Town
304.725.7011

Forage Testing Labs

Center for Agricultural & Natural Resources Development
West Virginia University
Extension Service

Ed Rayburn
Extension Forage Agronomist
WVU Extension Service
8/99

Drought situations result in low hay suppliesand many livestock producers feed supplemental grains or by-product feeds. To know what supplement is best to feed with a given hay, it is necessary to have a forage test of the hay done and to know the animal's feed requirement. Below is a list of forage testing laboratories in states surrounding West Virginia that can analyze forage samples for their nutritional quality. This list is not all-inclusive and is not intended as an endorsement of these facilities.

Many of these laboratories are members of the National Forage Testing Association. Member labs participate in a regular quality assurance program that tests their analytical procedures to ensure they provide accurate reports to customers. To see if labs are certified by the National Forage Testing Association, you can check the Association's member list on the WWW at http://www.foragetesting.org .

Many local feed stores provide forage testing services free or at a low cost to customers buying supplemental feeds. Check with local stores to see what services they provide.

Laboratories providing forage testing services:

Dairy One Forage Lab 730 Warren Rd Ithaca, NY 14850 800-344-2697 607-257-1272 607-257-6808 fax	Jefferson Laboratories 3867A Jefferson Pike Jefferson, MD 21756 301-473-4066 301-473-4345 fax jefflab@uno.com	Cumberland Valley Analytical Services 18501 Maugans Avenue Hagerstown, MD 21742 301-790-1980
Sky View Labs PO Box 273 Jennerstown, PA 15547 814-629-5441 800-273-8031	Dairy Tech Labs 805 Rohrerstown Rd Lancaster, PA 17601 717-295-8764	Brookside Laboratories, Inc. 308 S. Main St. New Knoxville, OH 45871 Greg Meyer 419-753-2448
Holmes Laboratory. Inc. 3559 US Rt. 62 Millersburg, OH 44654 303-893-2933		

Evaluation of Feedstuffs Versus the Price of Corn and 48% SBM

Date: August 16, 2010

Prices Used:	Corn		SBM (48%)	
	$174.98	Per Ton	**$382.00**	Per Ton
	$4.90	Per Bushel	$19.10	Per CWT
	$0.09	Per Pound	$0.19	Per Pound

The "Ton Value" is the nutrient value of the feed.

Feedstuffs

Roughages	**DM**	**CP**	**TDN**	**Ton**
	(%)	**(%)**	**(%)**	**Value**
Alfalfa Hay (early vegetative)	90	23.0%	63.0%	$208.53
Alfalfa Hay (mid bloom)	90	17.0%	58.0%	$169.54
Alfalfa Haylage	50	23.0%	63.0%	$115.85
Barley Silage	35	10.4%	60.0%	$53.18
Drought Stressed Corn Silage	30	10 %	62.0%	$45.76
Cottonseed Hulls	90	4.1%	45.0%	$82.66
Soybean Hulls	91	12.1%	77.0%	$168.78
Drought Affected Corn Silage	25	8.2%	62.0%	$35.45
Orchardgrass Hay (early bloom)	89	15.0%	65.0%	$166.34
Orchardgrass Hay (late bloom)	91	8.4%	54.0%	$119.21
Pasture (Grass\Legume Mix)	21	21.0%	69.0%	$48.03
Peanut Hulls	91	7.8%	22.0%	$72.37
Rolled Corn Stalks	85	5.9%	55.0%	$99.93
Concentrates	**DM**	**CP**	**TDN**	**Ton**
	(%)	**(%)**	**(%)**	**Value**
Barley Grain	88	12.8%	84.0%	$177.93
Beet Pulp, Dried	91	8.0%	74.0%	$144.28
Brewers Grains, Wet	20	25.4%	66.0%	$50.11
Brewers Grains, Dried	92	25.4%	66.0%	$230.49
#2 Corn	**90**	**10.0%**	**90.0%**	**$175.00**
Corn and Cob Meal	34	9.0%	83.0%	$149.53
Corn Distillers Dried Grains	93	29.7%	88.0%	$287.51
Corn.Dist.Dried Gr.w/Sol.	92	25.0%	88.0%	$258.58
Cottonseed, whole	91	24.0%	96.0%	$261.23
Cottonseed Meal, 41% sol.extd.	93	44.3%	78.0%	$354.71
Molasses, Cane Dried	94	10.3%	70.0%	$156.33
Oats Grain	89	13.3%	77.0%	$173.29
Corn Gluten	73	21.5%	78.0%	$178.99
Sorghum Grain (Milo)	89	9.0%	80.0%	$154.42
Soybeans, Whole	90	42.8%	91.0%	$352.71
Soybean Meal, 49%	**90**	**50.0%**	**84.0%**	**$382.00**
Wheat Grain	89	16.0%	88.0%	$202.30
Wheat Middlings	90	18.4%	69.0%	$191.88

Drought Related URLs

West Virginia University
Extension Service

Hay Sources

Hay 4 Sale
http://www.wvu.edu/~agexten/forglvst/hay4sale.htm

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

Jefferson County West Virginia
http://jeffersonfarms.org (Click on "Farm Listings by Product)

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

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

West Virginia University Resources

Drought Management Before, During, and After the Drought
http://www.wvu.edu/~agexten/forglvst/Drought.pdf

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

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/

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