Alternative Feeds for Beef Cattle During Periods of Low Forage Availability

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Introduction

Drought is a frequent challenge to beef producers, and many operations would benefit from developing a better drought management plan. Producers should be constantly aware of their pasture conditions, stored forage supplies, animal feed demand, and long-term weather forecasts. The recent widespread drought across the Southern U.S. has led to large harvested forage shortages, depressed local cattle prices, and along with other factors, has resulted in high supplemental feed prices. As part of a drought management plan, beef producers should consider emergency feeding programs based on underutilized roughage materials or limit-fed high concentrate rations. While these emergency feeding programs will lead to significant management challenges for most producers, securing the necessary feed supply and planning efficient delivery of the feed to the cattle early in the drought can result in a cost-effective approach to drought survival.

Limit-feeding high concentrate diets to beef cows

When drought is widespread and hay supplies are tight, it is often cost prohibitive to ship in hay for feeding beef cattle. Producers are faced with finding local feed resources which might be either concentrates or underutilized roughages. Concentrates can be successfully fed to beef cows as a major portion of the ration. However, some forage is recommended to maintain rumen function.

Loerch (1996) first published research from the Ohio State University with limit feeding corn-based diets to cows during gestation and in early lactation. Cows were either fed hay free-choice or limit-fed diets that were composed of a limited amount of grass hay, whole shelled corn, and a supplement providing protein (36% CP) minerals, vitamins, and in two of the three years monensin to provide about 200 mg/head daily. Averaged over three years, limit-fed cows consumed (DM basis) 2.2 lbs hay, 11.2 lbs of corn, and 2.5 lbs of supplement daily, as compared to 30.2 lbs of hay daily for cows fed free-choice hay. There were no differences in weight change, body condition score, or subsequent performance of the cows. In two additional trials, the effect of monensin

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was evaluated and it appeared that monensin tended to improve performance of the cows, although it did not appear to be necessary for a successful feeding program.

Feeding the limit-fed corn diets cost half that of feeding the hay-based diets, but economic calculations were based on hay at $80/ton, corn at $2/bu, and supplement at $150/ton. Based on current prices for feed ($4.50/bu corn, $300/ton supplement) breakeven value on the hay would be about $93/ton. Additional work from the same group (Schoonmaker et al., 2003) showed similar results and also showed that performance of cows in limit feeding programs was also comparable to cows grazing stockpiled pasture. Economic benefit of limit feeding corn-based diets was slightly better when compared to hay than when compared to pasture, but the limit-fed treatment was much less expensive than either high-forage treatment. Again, the economic comparisons have been greatly impacted by current feed prices.

Work from the University of Illinois (Tjardes et al., 1998) compared limit-fed high corn diets with hay-based diets for lactating cows. Unlike the Ohio work, studies were not started until cows had calved. In the first trial with mature cows, diets (dry basis) consisted of 10 lbs of alfalfa hay and 13.4 lbs of corn which was either whole or cracked, while cows fed hay free-choice consumed 35.4 lbs of alfalfa hay. A follow up trial with first calf heifers showed there was no benefit of adding 4% fat to diets on cow or calf performance. A digestion trial with the high-corn diets showed that grinding the corn improved diet digestibility substantially, but because there was no improvement in cow performance the final recommendation was that corn need not be ground.

The published research to date have focused primarily on corn-based diets with either grass or alfalfa hay, and obviously there are a myriad of possible ingredients that could be used in this kind of feeding program. General recommendations are for hay to be fed at 0.25% to 0.5% of body weight (the higher level when processed grains are used) and for monensin to be included in the diets (Lalman, 2003).

A great deal of work with growing cattle has shown very comparable results compared to corn and soybean meal for byproducts such as soybean hulls, corn gluten feed, and wheat middlings (Poore et al., 2002). However, while there have been many experiences feeding alternative concentrates in limit-fed diets to cows, no reports in the peer-reviewed literature were found evaluating common byproduct feeds in limit-fed cow diets, so that remains a research need. Also, no work has been published to determine the optimal level of hay to be fed with limit-fed high concentrate diets for brood cows regardless of the source of concentrate.

Managing cows on limit-fed concentrates presents management challenges that producers need to be aware of (Lalman, 2003). Cows fed in these feeding programs feel hunger despite being in adequate body condition. This may encourage the producer to over feed them, and also may cause them to find a way out of the field or pen where they are being fed. Cows are also very aggressive when being fed in this kind of program. Larger producers who have feeding equipment to mechanically prepare and deliver feed to the cows will get along better than smaller producers who

hand feed. Presenting cows with a limited amount of hay is also a challenge. Unrolling round bales, dropping flakes of square bales from the back of a truck, or making a total mixed ration for mechanical delivery are workable solutions.

Experience with this kind of feeding program has also shown that some cows don't respond well and lose body condition when most of the group maintain the desired body condition. This is likely due to competition at the feed bunk. Adequate feed bunk space (36 inches per cow) is critical, but even with adequate space some cows will not be able to compete and will need to be separated into a smaller group for adequate results.

Alternative roughage sources

Many alternative roughages are available for feeding cows during times of limited hay availability. Many of these products such as corn stover, soybean stover, and cotton gin trash have been considered by many to be too low in quality to be worth feeding. In North Carolina, it has been very rare to harvest either corn or soybean stover for cattle feed, and cotton gin trash and related materials have also seen very limited use. Table 1 shows the composition of several of these alternative roughages.

Table 1. Nutrient content of alternative roughage sources

Item	CP, %	ADICP, %	ADF, %	TDN, %	NEm, mcal/lb	Ca, %	P, %
Corn stover[1]	5.0	-	44	59	0.59	0.35	0.19
Corn stover[2]	6.3	1.5	49	55	0.44	0.31	0.12
Cotton gin trash[1]	10.0	-	51	42	0.40	1.70	0.25
Cotton gin trash[3]	12.2	6.5	65	-	-	1.01	0.22
Cotton gin trash[4]	11.7	-	-	47	-	0.90	0.20

[1] From Preston, R.L. (2007)
[2] From 122 samples submitted to the NCDA&CS forage lab in 2007.
[3] Samples from 8 NC gins from Rogers et al., (2002)
[4] 35 samples from Georgia from Stewart et al., 1998

Indeed these feed sources generally have low protein and energy levels, but because of the challenges with limit-fed concentrate programs, they may be more adaptable to a producer's feeding system. One factor that is common to most alternative roughages is that they contain little or no vitamin A activity, and coupled with drought and potential low cow stores of Vitamin A, supplementation with Vitamin A needs to be a high priority. The composition of these materials will also be quite variable and frequent analysis is recommended. Nitrate levels might be a problem in corn stover during drought years, so nitrate analysis is encouraged. Of the 122 samples making up the 2007 season values in Table 1, 25% had over 0.25% nitrate ion posing a slight risk to unadapted animals, while 10% had over 0.5% nitrate ion posing a moderate risk to unadapted animals. Only 3 of the 122 samples contained over 1% nitrate ion putting unadapted animals at high risk for toxicity.

Corn stover. Corn stalks are rarely harvested in the Southern U.S. as a cattle feed, while they are much more commonly utilized in the Mid-west especially in grazing programs (Klopfenstein, et al., 1987). However, because of the escalating cost of other feeds for beef cows, there has been a trend toward more of this material being harvested in recent years, especially during times of drought (Meyers and Underwood, 1992; Guthmiller, 2002). The corn residue comprises about 50% of the total above-ground corn plant, such that about 3 tons of residue per acre would be produced from a 100 bu/ac corn crop. Harvest efficiency is quite variable, but it is reasonable to expect to bale about 70% of the available material. Thus, you could expect about 2 tons of material per acre from 100 bu/acre corn. With increased corn acreage, this represents a very large unutilized source of roughage for cattle. For example, in 2006 North Carolina harvested 740,000 acres of corn with an average yield of 136 bu/acre. The residue from this crop represents a potential 2 million tons of corn stover. While much of this material is in areas of the state with limited cattle populations, substantial acreages are present statewide in close proximity to concentrated areas of beef production.

Despite the large amount of this material available, there is relatively little research with harvested corn stover. When cattle graze stalk fields, they are selective and refuse many of the lower quality materials present. Dropped ears, leaves and husks have relatively high energy levels compared the stems, and cattle will perform quite well early in the grazing period (Klopfenstein et al., 1987). However, with harvested corn stover, sorting is undesirable, and larger producers who adopt corn stover as an ingredient often purchase some kind of grinding equipment to reduce particle size and reduce sorting.

Performance of cattle fed ground corn stover has been disappointing relative to grazing stalk fields. When steer calves were fed diets containing high levels of corn stover (76%) and supplemented daily with either soybean meal or corn gluten meal, gains were 0.42 and 1.23 lb/day for soybean meal and corn gluten meal diets, respectively (Collins and Pritchard, 1992).

There has been interest in ammoniation of corn stover which generally improves intake and digestibility of the diet (Saenger et al., 1982; Klopfenstein et al., 1987). Saenger et al. (1982) showed that ammoniated corn stover supplemented with corn resulted in a 37% higher intake and 10% higher digestibility than untreated corn stover supplemented with soybean meal to give diets with similar crude protein and concentrate levels in one trial. However in another trial the increase in intake was only 5%. Cows fed the ammoniated corn stover with a corn supplement gained 17 lbs over a 70 day period and maintained body condition, while cows fed untreated corn stover with soybean meal supplement lost 45 lbs and tended to lose body condition. While ammoniation seems to have potential, there are issues such as safety and availability that greatly limit it's use in current production systems.

Work in Louisiana (Sanson and Coombs, 2000) evaluated corn stover as a wintering feed for dry brood cows for a 42 day period. Cows were supplemented with

either 1.3 lb daily of cottonseed meal (46% CP), or 3.3 lb daily of a mix of corn and cottonseed meal (18% CP). Cows on both treatments lost weight (32 lbs) and 0.5 body condition score during the 42 day trial. The conclusion was that the quality of the stalks was low because harvest had been delayed for 2 weeks to a month after corn harvest during which time significant precipitation resulted in deterioration of the material. It appears that timely harvest is an issue in harvesting an acceptable material.

In the summer of 2007 it was recognized in North Carolina that pasture conditions were poor, the hay crop was short, and there was little prospect for additional rainfall. As we studied the total feed need and potential feed resources available it was recognized that corn stover was a resource we had to capture. A cooperative effort between the North Carolina Department of Agriculture and Consumer Services and North Carolina Cooperative Extension was launched to raise awareness of corn stover as an emergency feed both to corn growers and beef producers. Six field demonstrations on harvesting and utilizing corn stover were conducted across the state at the start of the corn harvest, and funding was obtained from the Golden Leaf Foundation for transportation cost-share. Both extension agents and NCDA&CS regional agronomists worked with producers to effectively harvest and transport corn stover to cattle producers. As a result a large percentage of the corn acreage in cattle producing areas, and substantial acreages in eastern NC where cattle numbers are lower were harvested.

Early in the process it was recognized that much of the material was being harvested with excessive moisture. Published recommendations are to harvest at 70% or higher dry matter content (Myers and Underwood, et al., 1992). However, we observed that in many situations where corn stover was harvested at 70 to 75% dry matter bales heated to 140 ºF or higher. A search of the literature showed no information on the influence of baling corn stover at excessive moisture levels on eventual feeding value.

A study was done to compare harvesting at 70 or 90% dry matter. Bales harvested at 70% dry matter heated to peak temperatures of 142 ºF 5 days after baling while bales harvested at 90% dry matter heated to 107 ºF the day after baling and then cooled rapidly. Surprisingly, stover baled at 70% dry matter had only slightly lower ($P<0.05$) dry matter recovery (98.7%) than the stover baled at 90% dry matter (99.9%) after 2 months in storage. Studies comparing feeding value of these two stover treatments are being conducted at the present time.

Corn stover has great potential as a feed, especially for dry cows, and will be of interest in the future given the outlook for hay and other conventional feed prices. However, it must be stressed that it is a low quality feed and substantial supplementation is needed. Also, the material is hard on baling equipment, and waste during feeding may be excessive. However, when the material is chopped with a rotary or flail mower (with sharp blades), baled tightly with good binding (net wrapped bales hold together better than twine-tied bales), and supplemented appropriately it makes a very effective emergency feed source.

Cotton gin trash. Cotton production has resurged in the southern U.S. with about 865,000 acres harvested in NC in 2006. This represents approximately 150,000 tons of cotton gin trash that for the most part goes unutilized. Over 2 million metric tons of cotton gin trash are available across the cotton belt (Holt et al., 2000). The material has a relative low digestibility, but unlike corn stover has much higher protein level. The material is quite variable due to differences in the ginning process (Holt et al., 2000). Other related products such as gin motes, reginned mote waste, and cotton textile mill waste have better value than cotton gin trash and appear quite palatable and useful as cow feeds (Rogers et al., 2002). Transportation of cotton gin trash has limited its use because it has a low bulk density as it exits the gin. Compressing the material into modules (for transport within 100 miles of the gin) or into 800 lb square bales (for further transport) has aided in transportation of cotton gin trash in North Carolina.

Most research with gin trash has focused on chemical treatments (Conner and Richardson, 1987) to improve digestibility, but like chemical treatment of other low quality roughages, this practice has been poorly adopted due to safety concerns and high infrastructure costs.

In research at the University of Georgia, cotton gin trash was evaluated as a winter feed for dry beef cows (Hill et al., 2000a). Cows were housed in a dry lot and fed all the gin trash they could consume with or without a small amount of corn (1.4 kg/head daily). Intake of the gin trash was low during the first 10 days, but increased rapidly, so that they consumed an average of 27.9 lb/head of cotton gin trash dry matter daily over a 55 day period. Cows fed only cotton gin trash lost some weight and body condition over the period, while those supplemented with corn maintained weight and condition. Authors concluded that cotton gin trash was a viable feed for dry brood cows if supplemented with additional concentrate or forage sources. When the same workers fed cotton gin trash to growing cattle (Hill et al., 200b) with increasing levels of corn, there were dramatic associative effects on digestibility of the fiber in cotton gin trash, resulting in a conclusion that cotton gin trash had little potential for feeding at high levels to growing cattle.

Over a two year period at the Center for Environmental Farming Systems near Goldsboro, NC, (Rogers et al., 2002) half of the mature brood cow herd was fed cotton gin trash with some supplemental hay (approximately 4.5 kg/head daily) until two weeks before calving (49 days in year 1 and 42 days in year 2). The remaining half of the herd was fed bermudagrass hay ad libitum. Cotton gin trash was compacted into modules at a local cotton gin and transported to the pastures. Access to modules was restricted by a single strand of electric “polywire” and cows were allowed to sort the gin trash resulting in approximately 75% utilization before the wire was moved allowing access to more of the module. In year 1, cows were in excellent body condition (avg. initial score 6.2) so no supplemental feed was offered either group. During year 2, cows were in marginal body condition (avg initial score 5.2) so all cows received 1.1 kg whole cottonseed daily as a supplement. In the first year, cows on each wintering system gained weight (0.23 kg/d) and lost body condition (-0.5 score), while during the second

year both groups gained weight (1.1 kg/d) and improved in body condition (+0.5 score). There were no significant differences between the groups.

One major concern with feeding cotton gin trash is chemical residues. Stewart et al. (1997) obtained cotton gin trash from 26 gins in Georgia and tested for a wide variety of pesticides. Only arsenic and DEF (a common defoliant) were found in any samples, and both those were found at very low levels. However, some chemicals used on cotton do have a statement on the label that the gin trash should not be fed to cattle. This leaves some ambiguity about how to best manage chemical residue issues with gin trash.

Cotton gin trash is a viable emergency feed, especially for gestating brood cows, or for use in total mixed rations. Composition of gin trash will vary considerably from gin to gin, so the material should be analyzed frequently for a balanced ration. Feeding the gin trash to allow cows to refuse the least nutritional components will result in the best results. While gin trash will have a significant level of CP (often >10%) up to 50% of that CP will be in the acid detergent insoluble fraction and is presumably unavailable to ruminal microorganisms. However, work with other cotton byproducts suggests that nitrogen status is not lower in cattle fed diets formulated on crude protein, suggesting that the ADICP may not be truly unavailable. Additional research is needed to answer that question.

Recycled poultry bedding

One of the most abundant and inexpensive alternative feeds for brood cows in the southern U.S. is recycled poultry bedding (RPB). This material is more commonly known as deep stacked poultry litter, but the current popular name (RPB) appears to be more acceptable to both cattle producers and consumers. The material has long been in use in the U.S. and is backed by a very long history of research (Rankin et al., 2002).

In response to the discovery of the first case of BSE in the U.S., the FDA proposed to ban feeding of RPB in January 2004, and as a result many producers and advisors still believe that RPB feeding has indeed been banned. However, the FDA never followed through with the proposed ban and RPB is currently a legal feed ingredient.

New regulations aimed at reducing the risk of BSE to the US cattle herd are being considered, but it is very unlikely that a ban on RPB will be implemented in the near future. Given that, producers who have used RPB in the past can continue to incorporate it into their winter feed plan. It is also appropriate for producers seeking an emergency feed source to consider it for their winter feeding programs. As usual, the RPB should be deep stacked and allowed to heat prior to feeding which improves the feeding value and reduces pathogen potential (Capucille et al., 2004; Bush et al., 2007).

Other unusual alternative feeds

Drought induced feed shortages bring out interest in a wide variety of alternative feeds and it is beyond the scope of this paper to explore all of those. However, there are a few that deserve mentioning. There is a great deal of vegetable production and processing in the southern U.S., and many of the byproducts of that processing are potentially available for cattle feeding.

Vegetable processing wastes are high in moisture and spoil rapidly if exposed to air, but ferment readily if put in a pit or some other oxygen-free structure. Producers close to the site of production will generally explore the use of these feeds when other feeds are short. Pesticide residues have been a common concern with these processing wastes. Schnell et al., (1997) tested muscle, fat, liver and kidney samples for oncogenic chemicals from cattle that had been fed a variety of waste materials including potato processing waste, apple pomace, pear pomace, corn cannery waste, tomato pomace, grape solids, citrus pulp, cotton gin trash, or from cattle fed only conventional feeds. Very few samples had any detectable residues, and none had violative residues suggesting that there is not a major problem with feeding these materials.

Sweetpotatoes are produced across the southern U.S., and they frequently cause cattle deaths (Thibodeau et al., 2002). The deaths occur from the production of lung toxins that cause acute pulmonary emphysema. It is not unusual for producers to recognize that sweetpotatoes have potential feeding value and they dump them in pastures for cattle to feed on. As the material deteriorates the toxins develop and high levels of death loss may occur. In a case in Florida in 2000, sweetpotatoes were dumped in a pasture by a neighboring vegetable processing plant for approximately 6 weeks before cattle deaths were observed. In this case 42 of 110 cows died before the source of the problem was identified (Thibodeau et al., 2002). We have evaluated fermenting sweetpotatoes in an attempt to detoxify them (Thibodeau et al., 2004). Sweetpotatoes high in 4-ipomeanol (the primary lung toxin) and clean sweetpotatoes were ground and fermented. Lipid components were then extracted from the fermented material and injected into mice. Fermentation did not reduce lung toxicity, but fermentation does seem to be a viable method of storing sweetpotatoes to prevent toxin formation.

Cannery wastes are often fed free-choice to beef cows as a low cost feedstuff, and this practice may also result in production losses (Thibodeau et al., 2002). It was observed that cattle in several commercial herds fed free-choice sweetpotato cannery waste had severe dental erosion. This condition was caused by high levels of lactic acid in the slurry material which had a pH of 3.2. Neutralizing the material to 4.0 with recycled poultry bedding resulted in greatly reduced dental erosion and improved performance in growing steers (Rogers et al., 1999). This condition has been observed in other situations where highly acidic liquids are offered to cattle free-choice.

Summary

Drought related forage shortages result in increased interest by producers in locally underutilized feedstuffs. In most cases, use of local roughage sources or limit-fed concentrate diets will result in lower production costs than depending on hay hauled in from non-drought impacted areas. However, these unusual feedstuffs will lead to management challenges including increased labor, different equipment needs, and unconventional supplement needs. Producers need to employ a higher level of management when using alternative emergency feeds to achieve desired performance levels. While drought has stimulated interest in these feeds at the current time, escalating cost of traditional concentrates and hay in the future will maintain interest in these underutilized feeds even after drought conditions ease.

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SESSION NOTES