Georgia Master Cattleman

Beef Cattle Nutrition

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TABLE 1. NUTRIENT REQUIREMENTS OF THE COW HERD.

Body Wt. lb	Daily Gain lb	Min Dry Mat Consumption lb	Crude Protein lb/day	Crude Protein % in DM	TDN lb/day	TDN % in DM	Calcium gm/day	Phos gm/day	Vit A IU/day
Replacement:									
400	1.5	10.2	1.2	11.4	6.9	68	21	11	11000
600	1.5	13.8	1.3	9.5	9.4	68	20	13	14000
800	1	16.7	1.4	8.1	10.4	62	17	14	17000
Pregnant yearling heifers - last 3/4 months of pregnancy:									
700	0.9	15.8	1.35	8.4	8.5	54	19	14	19000
800	0.9	16.8	1.4	8.2	9.2	55	21	15	20000
900	0.9	18.3	1.5	8.1	9.9	54	22	17	22000
Dry Pregnant, mature cows - middle third of pregnancy:									
900	---	16.7	1.2	7	8.2	49	14	14	21000
1100	---	19.5	1.4	7	9.5	49	17	17	25000
1300	---	22	1.5	6.9	10.8	49	20	20	28000
Dry Pregnant, mature cows – last third of pregnancy:									
900	0.9	18.2	1.5	8	9.8	54	22	17	23000
1100	0.9	21	1.6	7.8	11.2	53	25	20	26000
1300	0.9	23.6	1.8	7.7	12.5	53	28	23	30000
Cow nursing calves – average[1] milking ability, first 3-4 months postpartum:									
900	---	18.8	1.9	9.9	11.8	57	24	19	33000
1100	---	21.6	2	9.4	12.1	56	27	22	38000
1300	---	24.3	2.25	9.2	13.4	55	30	25	43000
Cows nursing calves — superior[2] milking ability, first 3-4 months postpartum:									
900	---	18.7	2.4	12.9	13.1	70	35	22	33000
1100	---	22.3	2.6	11.9	14.5	65	38	27	40000
1300	---	25.3	2.8	11.1	15.9	63	41	30	45000
Bulls, growth and maintenance (moderate activity):									
1300	1	25.4	1.9	7.6	14.2	56	25	22	45000
1500	1	28.3	2.1	7.4	15.8	56	27	24	50000
2000	---	31.3	2.1	6.8	15.2	48	30	30	55000
2 year old heifers producing 10 lb milk, first 3-4 months postpartum									
800	0.5	17.6	1.9	10.8	11.2	64	27	19	31000
900	0.5	19.2	2	10.4	12	63	28	20	34000
1000	0.5	20.8	2.1	10	12.9	62	29	22	37000

Adapted from Nutrient Requirements of Beef Cattle, National Research Council, 1984.
[1]Average milking ability = 10 lb/day.
[2]Superior milking ability = 20 lb/day.

TABLE 2. NUTRIENT REQUIREMENTS FOR MEDIUM-FRAME STEER CALVES (DM BASIS)

Wt lb	Daily Gain	Protein %	Protein (lb)	TDN %	TDN (lb)	Ca %	P %	Minimum DM intake, lb
300	0.5	9.6	(.75)	54.0	(3.8)	0.31	0.2	7.5
	1	11.4	(.95)	58.5	(4.9)	0.45	0.24	8.5
	1.5	13.2	(1.14)	63.0	(5.5)	0.58	0.28	9
	2	14.8	(1.32)	67.5	(6.0)	0.72	0.32	9
400	0.5	8.9	(.87)	54.0	(5.2)	0.27	0.18	9.8
	1	10.3	(1.06)	58.5	(6.0)	0.38	0.21	10.5
	1.5	11.5	(1.24)	63.0	(6.6)	0.47	0.25	10.5
	2	12.7	(1.41)	67.5	(7.4)	0.56	0.26	11
500	0.5	8.5	(.98)	54.0	(6.2)	0.25	0.17	11.5
	1	9.5	(1.16)	58.5	(7.2)	0.32	0.2	12
	1.5	10.5	(1.33)	63.0	(8.1)	0.4	0.22	12.5
	2	11.4	(1.49)	67.5	(8.8)	0.47	0.24	13
600	0.5	8.2	(1.08)	54.0	(7.2)	0.23	0.18	13
	1	9.0	(1.26)	58.5	(8.2)	0.28	0.19	14

1.5	9.8	(1.42)	63.0	(9.3)	0.35	0.21	14.5
2	10.5	(1.57)	67.5	(10.1)	0.4	0.22	15

TABLE 3. ESTIMATED INTAKE OF COMMON FEEDS AND FORAGES

Item	DM Intake as Percent of Body Weight
Complete rations	
20% roughage	2.5%
40% roughage	2.75
60% roughage	2.75
Hays & Silage	
Good quality hay	2.0 - 2.5
Poor quality hay	1.5 - 2.0
Wheat Straw	1.5
Sorghum Silage	1.5 - 2.0
Corn Silage	2.5
Forages	
Grasses	
Vegetative growing	2.5
Mature	2
Dormant	1.5
Small Grain Pasture	3

NUTRITION MANAGEMENT FOR BEEF CATTLE
Guidelines and Rules of Thumb

I. FEED PROCESSING

The following rules of thumb are important if you are mixing feed on the farm:

* Premixes made on the farm are rarely justified. Purchase the premix of vitamins, minerals, feed additives, etc. that is best suited to your ration. Purchase no more than three months worth of premix at a time. Always follow label instructions. Add the premix to another ration ingredient (ex: soybean meal) to assure even distribution in the complete feed.

-- Flush grinder/mixer with grain after mixing medicated feed (to avoid residues).

-- Store medicated feed, premixes or supplements separate from other feeds.

* Preparation of the ration:

-- Avoid grinding too fine (this may result in digestive disturbances).

-- Finely ground feeds are more palatable when pelleted.

-- Pelleting prevents animals from selectively eating. However, pelleted roughage loses its effective fiber ("scratch factor").

-- Offer hay when a pelleted ration is fed.

-- Soaking does not improve feed value.

-- Proper timing on mixers must be observed. Avoid over and under mixing.

-- Fats control dustiness and decrease wear of machinery. Do no exceed 8% fat in the ration (handling problems and digestive problems may result).

-- Avoid moldy, stale or contaminate feeds. Mix no more feed than can be consumed in 3 weeks time.

* Purchase feeds from a reputable manufacturer if not grown on the farm. When selecting feeds, consider:

-- Cost per pound of ingredient (protein in soybean meal, TDN in grains, etc.), rather than

cost per ton.

-- Reputation of the manufacturer, dealer, elevator, etc.

-- Specific needs of your ration.

-- Feed tag information.

* When in doubt – use common sense.

II. BEEF CATTLE FEEDING

Observation

-- Fecal waste changes (color or consistency) indicate disorders.

-- Cattle should be hungry when fed. Look for calves which lag behind – they may be sick.

-- Rumination (cud-chewing) is a sign of good health. Look for this when cattle are at rest.

– Sore feet usually means acidosis. If caught in time, it may be reversed. Otherwise, founder and/or death may result.

Feed Consumption

-- Feed consumption and gains vary according to condition of animal, palatability of feeds, weather, and management practices.

-- Growing animals consume 2-3% of body weight in dry feed.

-- Finishing animals consume 2-2.5% of body weight in dry feed.

-- Herd bulls – in excellent condition will consume 1.5-2% of body weight; young bulls and thin bulls may consume double this amount.

-- Brood cows will consume 2-2.5% of body weight in dry feed.

-- 1 lb of hay is the same as 2-3 lbs of silage when figuring dairy consumption (they are not necessarily of equal nutritional value).

-- When silage is the major forage, cattle will consume 5 to 6 lbs. Per 100 lbs. body weight.

-- Grazing animals will consume 80-100 lbs. of green forage per 1000 lbs. body wt. when forage is lush. Consumption declines rapidly as quality of forage declines.

-- A brood cow will get a "body fill" on temporary winter pasture (rye, ryegrass, etc.) in 2 hours. This amounts to 7-8 lbs. dry matter and will usually meet a lactating cow's supplement protein and energy needs.

-- Cattle will drink 2 lbs. water for every 1 lb. of feed they eat.

Feeding

-- Keep all rations fresh, clean and palatable.

-- Feed by weight instead of volume.

-- Brood cows usually need a winter feeding program for about 140 days. This means you should plan for:
    1.5-2 tons hay or
    4-6 tons silage or
    1 ton hay plus winter grazing or
    2-3 tons silage plus winter grazing

-- Plan winter grazing:
    Overseeded ryegrass - 1 cow per acre
    Prepared seedbed - 1-1.5 cows per acre
    Limit grazing - 2-3 cows per acre

-- Forage test hay and silage to properly design feeding programs.

-- Stocker calves should gain 1.5-2.0 lbs./day.

-- Stock prepared seedbed winter annuals @ 600 lbs. per acre (initial stocking rate) in the fall.

-- Stock dryland millet at 3 calves (400-500 lbs. each) per acre.

-- Stock irrigated millet at 5-6 calves per acre.

-- Creep feed calves when:
    Forages are poor in quality
    Milk production is poor
    Grain is cheap and cattle prices are high

-- Creed-fed calves require 8-15 lbs. creed feed per lb. gain.

-- Teach calves to eat 3-4 weeks before weaning.

-- Whole oats is a satisfactory creep feed.
-- 15-20% roughage is usually needed in finishing rations.

-- Exception to the above is whole-shelled corn plus supplement (no hay or other roughage). Keep feed fresh and available on this program.

-- Never change feeds abruptly.

-- When in doubt - look it up or contact someone who knows.

Relative Feed Values

Grain	Feed Value%	Maximum in Ration%
Corn	100	100
Milo	90	100
Oats	90	33
Barley	90-95	100
Wheat	100	50
Rye	100	40

-- Always grind or roll milo (grain sorghum).

-- Molasses must cost no more than 75% of corn to be economical.

-- One lb. of urea plus 6 lbs. corn are equal in feeding value to 7 lbs. soybean meal.

Starting on Feed (Finishing Calves)

The most critical part of feeding is starting on feed – especially mill finishing rations. The following schedule should be followed.

Day 1-3 Free choice hay plus 1% of body weight as grain
Day 4-21 Increase grain by 1 lb. per day on every other day until desired grain consumption is reached.

-- Feed twice a day if possible

-- Sodium bicarbonate may help. Feed 0.15-0.20 lbs./head/day.

Minerals and Vitamins

-- Provide salt and minerals free-choice in loose form. Avoid blocks.

-- Cattle will consume salt-mineral mix at 3-4 oz./head/day when offered free-choice.

-- Always provide trace-mineral salt instead of plain salt (except when limiting feed intake with salt).

-- A good free-choice commercial mix contains at least:
20-30% salt
9-12% calcium
6-9% phosphorus

-- Home-made mix:
50% trace mineral salt
50% dicalcium phosphate or defluorinated rock phosphate

-- Cattle should consume 1 oz. magnesium oxide per day to avoid grass tetany. This can be provided by:
(1) Hi-Mag blocks which contain 13% magnesium
(2) Hi-Mag minerals which contain 13-15% magnesium

Home-made mix:
30% trace-mineral salt
30% dicalcium phosphate
30% magnesium oxide
10% oilseed meal, corn, or dehydrated molasses

-- Vitamin A is required in winter rations when fresh, green grazing is not available.

Brood cows require 20-30 thousand units vitamin A per day.

Provide by:
(1) Adding to feed (30 thousand units/head/day)
(2) Adding to mineral (14 million units/100 lbs. mineral)
(3) Inject animals with 1.5 million units in late fall

Self-Limiting Ration

-- Cattle consume 0.1 lbs. salt/l00 lbs. body wt. in salt-limited feeds (.5 lbs. for 500 lb. calf).

-- 1000 lb. cow will eat 1 lb. salt per day plus the feed it's mixed with.

-- To deliver 1 lb. Corn and 1 lb soybean meal per day to mature cows, then mix:

1 lb. salt
1 lb. corn
1 lb. soybean meal
Total consumption is 3 lbs.

-- Always use plain white salt. Trace mineral salt in these rations may cause toxicity.

-- Provide plenty of corn, fresh water. Water consumption may double with salt limiting feeds.

Ingredients to Limit in Rations

-- Limit urea to one third of total protein. This amounts to 0.25 lbs. of actual urea or 1.5% of mixed ration as urea.

-- Limit molasses to 7.5% of total ration.

-- Limit whole cottonseed to 5-6 lbs. per day.

-- Limit wheat to 50% of the grain in the ration.

Feed Additives

Rumensin - provide 200 mg/head/day
Bovatec - provide 200 mg/head/day
Sodium Bicarbonate - provide .15 lbs./head/day

-- Read and follow manufacturers' recommendations carefully.

NITRATES IN FORAGES

Nitrate toxicity is a complex problem and cattle respond differently depending on the circumstances. Symptoms may include unthriftiness, lowered milk production, weight loss, diarrhea, labored breathing and convulsions. However, many times the first apparent symptoms are abortions and sudden death. Pregnant cows are more susceptible than growing animals. The lethal dose is variable and depends upon the general health and nutrition of the animal. The following can be used as a guide when evaluating the level of nitrate in forage.

Nitrate Levels

Level of Nitrate in Dry Forage	Comments
0.0 - 4500	Considered safe to feed with adequate feed and water.
4500 - 6500	Generally safe under most conditions. If feeding pregnant animals, restrict to one-half to total ration.
6500 - 9000	Limit to one-half of total ration.
9000 - 15,000	Limit to one-third to total ration.
15,000 - 18,000	Limit to one-quarter of total ration.
18,000	Potentially lethal. Very risky to graze or feed. Dilute carefully.

Grass, millet, sorghum, sorghum-sudan or peanut hays are suspected if they have been heavily fertilized and harvested after drought conditions. Please urge cattlemen with suspect hay to have it tested. Test kits of diphenylamine blue (DPB) are available from the Veterinary Extension Office in Athens. The DPB test only indicates the presence of absence of nitrate, not the quantity. If the test is positive, then send a representative sample to the Soil Testing and Plan Analysis Lab. Ask specifically for nitrate.

Nitrate toxicity can be minimized when adequate energy and high levels of Vitamin A are fed. A suggested program would be 2-5 lbs. corn plus 30 to 50 thousand units of Vitamin A per day, or a one time injection of 1 l/2 million units. Diluting the suspect hay with “clean” hay is advised. If you have an questions, contact the Extension Veterinary Science or Extension Animal Science Department.

Creep Feeding Beef Calves

Creep feeding is the practice of providing supplemental feed to nursing calves. This is done usually with the use of a creep gate, large enough for calves to enter the feeding area, but too small to allow cows to pass. Creep feeding can be implemented in various forms or systems, but regardless of method chosen, use it judiciously. Treat creep feeding as management decision rather than an annual management practice. The type of creep feeding system varies from grain-based energy creeps to limit-fed protein creeps to creep grazing. Each system produces a general response of increased growth, which is not always profitable. Creep feeding like any other supplementation practice, must be analyzed based on estimates of expected increases in performance and income compared to the costs of these improvements.

There are a number of factors that need to be evaluated, regardless of creep system, before creep feeding is implemented.

1. First and foremost is the cost of the added grain. It is futile to spend more than the market price to produce additional weight gain. The conversion of feed to gain can vary from 3 to 12 pounds of feed for each pound of gain above non-creep fed calves. The interrelationship between feed conversion and feed cost determines the cost of gain.

COST/LB OF GAIN FROM CREEP FEEDING

Feed Conversion(lb. Feed/lb. Gain) Feed/Extra Gain	5	6	7	8	9
	(Cost cents/lb.)				
Cost of Feed per CWT ($)					
3	15	18	21	24	27
4	20	24	28	32	36
6	30	36	42	48	54
8	40	48	56	64	72
10	50	60	70	80	90
12	60	72	84	96	108

In a creep grazing system the increase in calf weights would have to be evaluated against the cost per acre of creep forage, the number of calves carried per acre, and amount of extra gain produced per acre of creep grazing.

2. One factor that greatly affects creep feed consumption and efficiency is the quantity and quality of available forage. If plenty of high quality forage is available, intake of the supplemental feed or grazing will be reduced and the

benefits in animal performance over the no creep system will diminish. Creep

feeding has been the most effective in drought situations or whenever quantity or quality of pastures do not meet the calf's requirement for growth.

3. Another point, not often considered, is time of supplementation. Spring-born calves nursing their dams do not usually require any supplementation until mid-late summer when forage quality and the cow's milk production start to decline. If high quality summer grazing is present, creep feed is not warranted at all.

4. One drawback to creep feeding is that it tends to cover-up the poor milking performance by some cows. If culling and selection are based on weaning weight, creep feeding invalidates this method of selection. Calves of poor milking cows eat more feed to makeup for what they have not received from the cow. If you do creep feed, weigh calves prior to the supplementation period to obtain an estimate of the cow's performance.

5. Another point to raise is whether or not you plan to retain any calves for a winter stockering program. If calves are heavily fed and fat at weaning, it could diminish their expected performance through the winter. In this case use a more moderate level of supplementation, if any at all.

6. One last precaution is the creep feeding of future replacement heifers. While supplementation of these calves probably helps them reach breeding weight at an earlier age, it may also lead to lower milk production. Research over the past 30 years shows that high energy supplementation and fattening of heifers, prior to weaning, causes a decrease in mammary development and subsequent milk production.

HIGH ENERGY-GRAIN CREEP SYSTEM

By far supplementation with ad libitum concentrate feeds is the most widely-used creep system. Under most circumstances this system will produce the most additional gain and fattening of calves, but not necessarily the most return. Research shows that calves will reduce their forage consumption and mainly consume the creep feed. This becomes more similar to full feeding than supplementation. The efficiency of a grain creep system varies from 5:1 to 10:1, this is in situations of inadequate forage such as during the winter or droughts. In other cases feed efficiency has ranged up to 20:1, clearly an uneconomical level.
Success with this creep system fluctuates with cattle and grain prices, available forage, type of cattle and management system. With the high grain creep system, many ration combinations can be utilized to achieve satisfactory results. Example rations are shown in the table of examples. Ingredients and ingredient amounts can varied according to the desired rate of gain and feed cost. Whole or rolled grains make a simple satisfactory creep feed and are more palatable than

finely-ground grains.

Creep feeding can be accomplished using either a self feeder with a creep gate attached or by using a creep gate to divide off a separate creep area and placing a trough inside. It takes time for calves to use either type. Locating feeders around loafing areas and spreading hay in creep areas will help the calves find the feed quicker.

TABLE 2. EXAMPLE CREEP RATIONS

	Ration			
Ingredient %	1	2	3	4
Corn	90	20	67	50
Oats	--	30	33	--
Soybean Meal	10	10	--	15
Alfalfa pellets	--	--	--	15
Cottonseed hulls	--	--	--	15
Molasses	--	--	--	5

LIMIT-FED HIGH PROTEIN

Research conducted at the University of Georgia indicates that cotton seed meal or soybean meal limit-fed with salt, can stimulate an efficient increase in weaning weight. The major activity of high protein creep feed is to increase forage digestibility and forage intake. The systems works best when forage quantity is plentiful, but lacking in protein content. In these situations, the conversion of creep feed to added gain has ranged from 2 to 3 with calves consuming about one pound/day of cotton seed meal.

From 8 to 10 percent salt has been effective in limiting daily intake to about one pound soybean or cottonseed meal. Intakes should be limited to about this level because most of the favorable effects on forage digestibility and intake are achieved more efficiently with the first pound of protein creep. Beyond the one pound level, additional protein creep will likely be used for energy and the conversion of creep to added gain will become less efficient.

A few points in using this creep system are: (1) it normally takes two to three weeks for calves to start consuming creep, (2) start with 0 to 3 percent salt in feed and increase salt as necessary to keep consumption around one pound/day, (3) locate creep feeding areas where cows lay during the day, (4) hay spread in creep area helps attract calves to creep initially and (5) salt is corrosive to metal creep feeders, but rubber pans or wood troughs work quite well.

The figures in the table below are from research trials conducted at the Central Branch Experiment Station located near Eatonton from 1987-1989. The pastures used in the trials were a mixture of common bermudagrass and tall fescue.

TABLE 3. PERFORMANCE OF CONTROL AND CREEP-FED CALVES

	Treatments	
	Control	Creep
Number of calves	43	20
Initial weight, 7-1-85	309	307
Final weight, 10-10-85	509	530
Weight gain, 101 days	200	223
Pounds creep/calf		61
Pound creep/lb added gain		2.65
Cost of added gain		6.1
Value of added gain		13.8
Profit		7.7

Cottonseed meal costing .10/lb including labor. Added gain valued at .60/lb.

Additionally, these trials monitored calf weight change through the first seven days post-weaning. During this 7 day period, creep-fed calves consumed more feed (hay & grain) and lost less weight than control calves.

CREEP GRAZING

All creep feed does not have to come from a feed bag. An alternative to purchasing creep feed is to raise it. Creep grazing programs can produce additional calf gains using forage rather than the traditional grain-based creep diets. There are many ways to adapt this system to each individual situation, but the bottom line is that it must be profitable.

The calf's response to creep grazing depends on the quality of grazing it has access to already. If the calf is grazing a high quality grass-legume forage, then the expected benefits of creep grazing would be minimal. Or if calves are grazing fungus infected fescue or any other poor quality forage, then creep grazing would be beneficial. Regardless of forage quality, if forage quantity is a problem, then creep grazing should have a positive effect on calf performance and probably cow performance as well.

Two different methods of allowing calves access to creep forage, while keeping cows out have been used. One method is to build a typical creep gate with entrance slots 18 inches wide and place it in the fence line or at the gate separating the creep grazing area from the main pasture. Use strand of electric wire to allow calves to graze while

keeping cows out. Placing this single strand of wire 36 to 42 inch above ground to allow calves to pass under it while keeping the cows out.

Different forages can be used for successful creep grazing successfully as long as they are high in nutrient quality and readily available. Research with Tifleaf 1 Pearlmillet shows that calf average daily gain was increased from 1.4 pound/day to 2.1 pound/day from late June to October 1. As a result creep grazed calves weighed 80 pounds more at weaning. Using summer annuals such as pearlmillet calves can be stocked at six to ten per acre of creep forage. If the forage gets ahead of the calves, turn the mature cows in to harvest the excess forage.

For fall-born calves, winter annuals such as ryegrass, rye and wheat can also be used effectively for creep grazing. Research in Louisiana has demonstrated a 91 pound increase in weaning weights when calves creep grazed winter annuals. Stocking rates and management of unused forage can be handled similarly to that previously discussed for summer annuals.

Creep grazing has a couple of other indirect benefits. One is that calves do not get as fat as when they are grain creeped. This is particularly important for replacement heifers, where research shows that getting young heifers excessively fat reduces their milk production. The other benefit is that cows with creep grazed calves are fatter and weighed more than control cows going into the winter. Having cows go into winter in good shape is a big advantage on most any operation.

As with most management alternatives, creep grazing has its disadvantages. First and foremost is the time and labor required to plant a creep forage. Calves could also be susceptible to prussic acid poisoning and bloat with some forages. Proper management can alleviate these problems. Finally, remember that creep grazing may not be advantageous if the main pastures are high in legumes or of good quality.

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WINTER FEED YOUR BROOD COWS PROPERLY

The dollars spent in wintering brood cows often make the difference in profit or loss in a beef herd. Wintering costs represent 35 to 45 percent of the annual expense for keeping a cow. Proper feeding exerts a tremendous influence on a cow's fertility and calf weight at weaning. Beef cattle producers must plan their winter feeding strategy to meet the cow's nutritional requirements and do it as cheaply as possible. With the varied weather, soil types and forages in Georgia, cattlemen must analyze their individual situations and use their resources for a successful feeding program. Cattlemen in most sections of the state will need a 90- to 120 day supply of stored winter feed. Proper planning will enable cattlemen to feed brood cows successfully during the most critical season of the year.

REQUIREMENTS

The protein and energy requirements of beef cows at different stages of production are presented in Table 1. Note that protein and TDN (total digestible nutrients) requirements of dry pregnant cows can usually be met with good quality forage. However, after a cow calves, there is a tremendous increase in protein and energy requirements.

Improper nutrition before or after calving will have a serious impact on conception rate and weaning weight. Research indicates that under feeding protein and energy before or after calving can reduce the conception rate as much as one third and weaning weight by as much as 50 pounds. Either situation is unacceptable in today's competitive field of beef production.

The nutrient requirements of beef cows can be affected by other factors to a lesser degree. Other major factors are age and productivity.

AGE: Cows less than three years old have higher nutritional requirements than other cows. Younger cows have greater nutrient needs because, when compared to older cows, they have similar requirements for gestation and lactation but they have additional requirements for growth.

PRODUCTIVITY: The amount of additional protein and energy required post-calving s directly related to the milk production potential of the cow. Superior milking cows require 10 to 20 percent more protein and TDN (Table 1). This additional nutrient requirement is not accompanied by a similar increase in dry matter intake; therefore, protein and TDN requirements have to be met with higher quality forages or more supplementation. Usually, cows that fall into the superior milking category are beef-dairy crossbred cows.

Cows with larger frames sometimes require more supplementation than smaller cows when consuming low quality roughages. This does not mean they are less efficient, but that they require more total feed due to their increased size and weight.

COMPOSITION OF FEEDSTUFFS

Fitting a winter feeding program to an individual operation depends on the base forage program (hay, silage or winter grazing) and what type of supplements are available. The protein and TDN content of commonly used roughages and supplements are presented in Table 2.

The rate of supplementation varies greatly with the quality of hay or silage being fed, so a forage test is required to design an accurate feeding program. Your county Extension agent has forage testing information available upon request. Do not guess the quality of your forage. Send a sample to be tested and supplement according to the test results. The recommended program will help you feed for the highest production at the lowest cost.

SAMPLE FEEDING PROGRAMS

The information in Table 3 serves as a guide in determining the amount of supplemental protein and energy necessary to meet the daily nutritional needs of pregnant dry cows and lactating cows consuming various qualities of forage.

The following recommendations can be used as a guide for planning a winter feeding program in various situations. Remember in all instances to provide a complete mineral mix free choice. Substitute a high magnesium mineral (14 percent Mg) free choice during the grass tetany season.

PREGNANT DRY COWS

Situation A: There is an abundance of frosted grass, corn stalks and other roughage. Essentially, there is plenty of roughage available, but it is of poor quality. Each of the following supplements alone should balance this forage in meeting the cows nutrient requirement.

1. Feed one pound of cottonseed meal (CSM) or soybean meal (SBM) per head daily, or every other day at double the daily amount.

2. Provide 30 to 35 percent protein liquid supplement or protein blocks free choice.

3. Feed two to three pounds of 20 percent protein range cubes per head daily.

4. Provide a hot-mix of 25 percent plain salt and 75 percent cottonseed meal free-choice.

Situation B: Pastures are short or grazed off, and stored forage must be fed. A forage test will allow more accurate and efficient supplementation or determine if supplementation is needed.

1. Feed hay free choice (18 to 22 lbs/head/day). Most hay contains enough protein and TDN. Poor quality hay should be supplemented as in Situation A.

2. Limit feed corn or sorghum silage to 40 lbs/head/day plus one pound of CSM, SBM or free-choice liquid supplement or protein blocks.

3. Limit grazing of winter annual pastures to two hours every other day to supplement free-choice hay or silage feeding programs. The stocking rate should be two to four cows per acre depending upon the amount of grazing available.

Situation C: Fescue or fescue and clover are available. If forage is plentiful, no hay or supplement is needed. Hay feeding may be used to lengthen the amount of time that forage is available. After hard freezes or prolonged cold weather, supplemental forage will be necessary.

LACTATING COWS

Situation A: Pastures are short or grazed off. Supplemental forage is required. Forage test results win allow a more accurate and efficient supplementation program to be devised.

1. Provide good quality hay free choice and supplement protein and energy. Possible supplements include - four to five pounds of whole cottonseed - one to 1 ½ pounds of CSM or SBM plus two pounds of corn - six pounds of a mixture of 60 percent broiler litter and 40 percent ground corn - free-choice liquid supplement or protein blocks plus two pounds of corn with good quality hay. Poor quality forages will require additional protein above what the liquid supplements and blocks furnish.

2. Corn silage fed at 50 to 60 lbs/head or free choice. Supplemental protein can be furnished with - 1 ½ to two pounds of CSM or SBM - four to six pounds of broiler litter- four to five pounds of range cubes

3. Sorghum silage fed at 50 to 60 lbs/head or free choice. Supplemental protein can be furnished with - two to 2 ½ pounds of CSM or SBM - five pounds of whole cotton seed - six to eight pounds of broiler litter - six to seven pounds of range cubes.

4. Limit grazing of winter annual pastures, two to four hours per day or four to six hours every other day, in addition to free-choice hay. The stocking rate should be two to three per acre depending upon the amount of grazing available.

Situation B: Fescue or fescue and clover are available. If adequate forage is

available, two lbs/head of corn should be supplemented. Hay feeding may be used to lengthen the amount of time that forage is available. After hard freezes and during prolonged cold weather, supplemental forage will be necessary.

REPLACEMENT HEIFERS

The wintering period is an important time for replacement heifers. If plans are to breed heifers to calve at two years of age, then they must receive adequate wintering rations. Research indicates that heifers must be in the 650 to 750 pound weight range (66 percent of mature weight), depending on breed, if they are to cycle and conceive at 14 to 15 months of age.

Generally, heifers must gain around 1 1/4 to 1 ½ pounds per day from weaning until breeding age. Separation of heifers by weight at weaning will save money in wintering heifers. Heavy heifers may need to gain only 3/4 pound per day while light heifers may need to gain 1 ½ pounds per day. The following rations can be used:

1. 0 to 14 pounds of good quality hay (free choice), with one pound of CSM or SBM and three pounds of corn,
2. 25 to 30 pounds of corn silage (free choice) with 1 ½ pounds of CSM or SBM,
3. Winter grazing free choice plus two to four pounds of hay per day, or
4. Winter grazing and corn silage.

If hay quality if fair to poor, ration choice I needs an additional one to two pounds of corn. When utilizing winter grazing in ration choices 3 and 4, heifers should be stocked at one to two heads per acre, depending upon the amount of available forage.

SUMMARY

There are many other combinations of forages and concentrates that can be used to winter cows in Georgia. These are only a few examples. Analyze your own situation and use a system that will work for you. Separate the cattle in your herd by classes - dry pregnant cows, cows with calves, replacement heifers, first-calf heifers - for proper feeding of each group. Forage testing will allow you to economize on your feeding program while still meeting the cows' requirements for growth, milk production and reproduction.

TABLE 1. BEEF COW REQUIREMENTS PER DAY (LBS) AND PERCENT OF RATION (%)

Dry Matter Basis
900-1100 lbs.

Dry Pregnant Mature Cows

	Dry Matter	Crude Protein		TDN	
	LBS	LBS	%	LBS	%
Middle Third of Pregnancy	16.7 - 19.6	1.2 - 1.4	(7.0)	8.8 - 9.6	(49)
Last Third of Pregnancy	18.2 - 21.1	1.5 - 1.7	(8.0)	9.8 - 11.3	(53)
Cows Nursing Calves First 3-4 Months Average Milking Ability	19.4 - 22.0	1.9 - 2.2	(10.0)	11.2 -12.8	(58)
Cows Nursing Calves First 3-4 Months Superior Milking Ability	19.4 - 22.0	2.4 - 2.6	(12.0)	13.3- 14.5	(68)

TABLE 2. AVERAGE ANALYSIS OF CERTAIN FEEDS (Dry Matter Basis)

Roughages	Dry Matter %	Crude Protein %	Total Digestible Nutrients %
Corn Silage	35	8	68
Sorghum Silage	30	6	57
Coastal (good)	88	10	52
Coastal (poor)	88	6.5	47
Fescue (good)	86	10	52
Peanut Hay	90	10	48
Soybean Hay	88	12	49
Bahia Hay	90	8.2	50
Soybean Stubble	90	5	40
Supplements			
Soyhulls	90	12.1	80
Corn	89	10	90
Sorghum Grain	88	10.1	84
Barley	89	13.5	84
Wheat	89	14.5	88
Oats	90	13.3	76
Soybean Meal, 44%	90	49.9	84
Soybean Meal, 48%	90	55.1	87
Cottonseed Meal, 41%	94	45.2	78

TABLE 3. SUPPLEMENTATION SCHEDULE[1]

Forage Analysis						
			Dry Cows[2] (900-1100 lbs)		Lactating Cows[3] (900-1100 lbs)	
Forage Quality	Crude Protein (%) of DM	TDN (% of DM)	Lbs. CSM	Lbs. Corn	Lbs. CSM	Lbs. Corn
Excellent	11.2 & over	56 & over	none	none	none	none
Good	9.5 - 11.1	56 & over	none	none	1	none
		53 - 56	none	0.5	1	1
		50 - 53	none	1	1	2.5
Fair	8.2 - 9.5	54 56	none	0.5	2	none
		51-54	none	1	2	1.5
		under 50	none	2	2	2.5
Poor	7.3 - 8.2	53 - 55	none	0.5	2.5	0.5
		51 - 53	none	1	2.5	1
		under 50	none	2	2.5	2
	under 7.3	under 48	1	2	3	3

[1]Recommendations are made on the basis of 41 percent cotton seed meat and ground-shelled corn. Other supplements can be used when fed to deliver the same amount of energy and protein. 2 Dry cows in the last third of pregnancy. 3
Superior milking cows in the first three months of lactation.
[2]Dry cows in the last third of pregnancy.
[3]Superior milking cows in the first three months of lactation.

PROTEIN SUPPLEMENTS FOR BEEF COWS

Ronnie Silcox and Robert L. Stewart

Feed is a major portion of the annual carrying cost of brood cows. Cattlemen can normally grow enough forage to meet most of their needs. However, additional protein and in some cases energy are often required to properly balance a ration for growing animals and lactating brood cows. Protein supplements cost more than grains or forages used in feeding the cow herd. Proper selection and efficient use of protein supplements can reduce maintenance costs.

PROTEIN REQUIREMENTS

In a mature cow, protein is required for normal body maintenance and for the growth of hair, horns, and hooves. In mature cows, proteins are also required for maintenance of pregnancy and milk production. In young animals, protein is needed for maintenance and growth.

Symptoms of protein deficiency are weight loss, poor growth, poor reproductive performance, reduced milk production and decreased appetite. When cattle are fed low quality forages, total feed intake will usually increase when a high protein supplement is fed.

The amount of protein required by a cow depends on the stage of her reproductive cycle. A dry cow requires less protein than a lactating cow. The highest demands for protein occur shortly after calving, when increased protein is required for milk production and for reconditioning the reproductive tract. Requirements for protein and total digestible nutrients (TDN) are given in Table 1, page 19 for mature beef cows. TDN is a measure of energy available in a feed. Supplemental energy as well as protein is often required.

Heifers and young cows have higher requirements for protein than mature cows since these animals are still growing. Table 3 lists requirements for yearling heifers and lactating 2-year-olds.

To feed a well-balanced ration and keep cost to a minimum, it is best to group cattle by their needs. The most efficient feeding program consists of four groups: mature dry cows, mature lactating cows, first-calf heifers and replacement heifers. With the same base forage, each group will require a different supplementation program.

A well-designed feeding program starts with forage analysis. Submit a sample to the Soil Testing and Plant Analysis Lab. Your county Extension Agent has the information and sample forms needed for forage testing. Upon request, the Extension animal scientist will also custom balance a ration based on analyses of the forage and feed stuffs available.

TABLE 3. NUTRIENT REQUIREMENTS OF BEEF IN YOUNG BREEDING CATTLE (DRY MATTER BASIS)[1]

Wt.	Daily Gain	Dry Matter	TDN[2]		Total Protein	
(lbs)	(lbs)	(lbs)	(lbs)	(%)	(lbs)	(%)
Pregnant Yearling Heifers - last third of pregnancy						
700	0.9	15.3	8.5	55.4	1.3	8.4
700	1.4	15.8	9.6	60.3	1.4	9
800	0.9	16.8	9.2	54.8	1.4	8.2
800	1.4	17.4	10.4	59.6	1.5	8.8
900	0.9	18.3	9.9	54.3	1.5	8.1
900	1.4	19	11.3	59.1	1.6	8.5
Two-year old cows nursing calves - first 3-4 months after calving-Average Milk						
800	0.5	17.6	11.2	63.8	1.9	10.8
900	0.5	19.2	12	62.7	2	10.4
1000	0.5	20.8	12.9	61.9	2.1	10

[1]From: Nutrient Requirements of Beef Cattle, Sixth revised edition, 1984.
[2]Total Digestible Nutrients

BUYING PROTEIN SUPPLEMENTS

There are many different and satisfactory ways to supplement protein to beef cows. Since cots, crude protein (CP) content and percent Dry Matter (DM) of different type supplements vary a great deal, base your buying decisions on price per pound of protein or energy, not price per pound of supplement. Cottonseed meal (CSM) at $190 per ton seems cheaper than soybean meal (SBM) at $200 per ton. However, calculate the protein value before you decide which to purchase. Use the protein content and percent dry matter of protein supplements listed in Table 4 (page 23) to determine the cost per unit of protein from the various sources. An example would be to compare CSM and SBM at the prices quoted above.

Use the following formula:

1. $\text{Unit wt.} \times \frac{\%\ \text{DM}}{100} \times \frac{\%\ \text{CP}}{100} = \text{lb. CP/unit}$

2. $\frac{\text{Cost/unit}}{\text{Lbs. CP/Unit}} = \text{Value/lb. CP}$

For a ton of CSM:

1. $2000 \times \frac{91}{100} \times \frac{45.2}{100} = 822.6$ lbs. CP/ton CSM

2. $\frac{\$190/2000 \text{ lbs}}{822.6 \text{ lbs CP}/2000 \text{ lbs}} = \$.230/\text{lb CP}$

For a ton of SBM:

1. $2000 \times \frac{90}{100} \times \frac{49}{100} = 822$ lbs. CP/ton

2. $\frac{\$200/2000 \text{ lbs.}}{822 \text{ lbs. CP}/2000 \text{ lbs.}} = \$.227/\text{lb CP}$

In this case, while CSM is cheaper per ton, SBM is the better buy, since cost per pound of protein is cheaper from SBM ($.227) than from CSM ($.230).

In addition to considering the price per pound of protein or energy, consider the labor and processing involved with using various supplements. The cost of mixing and feeding sometimes outweighs the difference in value.

TABLE 4. COMPOSITION OF SOME COMMON PROTEIN SUPPLEMENTS (DRY MATTER BASIS)

Feed	Percent Dry Matter	Percent Protein	Percent TDN
Cottonseed Meal, 41%	91	45.2	72
Cottonseed	92	23.9	96
Soybean Meal, 44%	90	49	84
Soybeans	92	42.8	91
Urea	100	287	--

UREA USE IN CATTLE SUPPLEMENTS

Beef cattle are ruminants, which means they have four stomach compartments. The largest compartment (rumen) contains microorganisms that break down feeds. These microorganisms convert non-protein nitrogen compounds to proteins. This type of digestive system enables cattle to consume feeds that should not be fed to simple stomach animals like the pig.

Urea is used in many commercial protein supplements and is sometimes used in mixing feed on the farm. If properly used, urea is an inexpensive protein source. If improperly used it can be toxic to cattle. When urea enters the rumen it is rapidly converted into ammonia. This ammonia

can be used by microorganisms along with a readily available energy source to produce proteins. If an energy source is unavailable or if too much urea is consumed, a large proportion of the ammonia enters the blood system. If ammonia enters the blood faster than the liver can remove it, cattle develop ammonia poisoning (urea toxicity). This can result in death in less than 30 minutes.

Urea is best utilized in well-balanced high energy rations with crude protein levels of less than 12 percent. Urea is not well utilized for supplementing low quality forages such as wheat straw, fescue hay or bermudagrass hay. Research summary shows that cows on poor quality winter forages do not perform as well with urea-containing supplements as with cottonseed or soybean meal supplement. Urea can be used as the only source of supplemental protein when cows are wintered on corn silage.

When properly used, urea is an inexpensive source of protein. Follow these precautions:

1. Mix feeds thoroughly when urea is used.
2. Do not feed to starving cattle.
3. Feed in conjunction with readily available energy sources, such as grain or molasses.
4. Never offer a feed containing urea to cattle that have access to raw soybeans.
5. Do not feed to calves under 400 pounds.

COMMERCIAL PROTEIN SUPPLEMENTS

Several types of commercial supplements on the market such as range cubes, protein blocks and liquid supplements work well, but, there are usually less expensive supplements available. For some producers the convenience of feeding or savings in labor are worth the added cost.

The protein and TDN content of these supplements vary from one manufacturer to another. Base your buying decisions on cost per pound of protein rather than price per pound of supplement. Look for the percent protein on the product label. The label should also indicate how much of the protein is from urea.

Various methods are used to restrict the intake of blocks and liquid supplements. Intake varies with the type of supplement and availability of forage. Check on the expected consumption before you buy. Some products will supply too little or too much of the required nutrients.

Range Cubes or Pellets

Several feed companies produce range cubes or pellets. These cubes usually contain a mixture of grain, oilseed meal, and minerals. They may or may not contain urea. Protein and TDN content vary with manufacturers, but the TDN content is usually not very high. Cubes are usually scattered on the ground for feeding. An advantage and a disadvantage to using range cubes is that they usually are fed daily. The advantage is that is gives the producer a chance to check the cows each day, however, daily feeding does require more labor than some other supplementation programs.

Cubes that contain urea should be fed daily. Feeding larger amounts two to three times a week should not be done when cattle are on low quality forage. If done, the urea will not be utilized properly by the cattle.

Liquid Protein Supplements

Liquid supplements are available from several feed companies and are offered free-choice in a "lick tank". Protein content is usually about 32 percent and varies with suppliers. Consumption is usually restricted to one to two lbs/head/day by the addition of phosphoric acid.

The major advantage of liquid supplement is that little or no labor is required for feeding. However, cost per pound of protein can be higher than other supplements. Since liquid supplements contain urea, observe precautions for feeding urea. Feed cattle free-choice hay before tanks are placed in the pasture. Once cattle are started on liquid supplements, do not let the tanks run dry. Hungry cattle may consume too much urea from a newly filled tank. Do not feed liquid supplement that contain urea to cows that have access to soybean stubble.

The molasses in liquid supplements provide energy, but, the additional energy is usually insufficient for the proper utilization of urea when cattle are on low quality grass or grass hay. Liquid supplements can work well in conjunction with corn silage or when cows are grazing corn fields in early fall.

Protein Blocks

Protein blocks are compressed blocks of protein supplement that usually weigh from 30 to 500 pounds. Place blocks in an area of the pasture that cattle use frequently. Intake is usually limited to two lbs. Per day by the hardness of the block, salt content and fat content. Cows normally take two to three weeks to adjust to blocks. During this period they may consume more or less than desired. The composition of blocks does vary and they may or may not contain urea.

OIL SEEDS AND MEALS

The cotton and soybean industries are major source of protein supplements for cattle. Soybean Meal (SBM) and Cottonseed Meal (CSM), two by-products of the oil industry, are commonly-used protein supplements. Whole raw soybeans and cottonseed may also be fed to cattle.

Oil Seed Meals

The most common oil seed meals are cottonseed meal and soybean meal. These are available through most feed suppliers. Both are excellent protein supplements for cattle particularly for cattle on low quality forages. Base your choice of CSM and SBM on price per pound of protein.

The amount of protein and energy supplementation required for cows depends on the quality of

available forages. Forage quality varies greatly with fertilization rate, maturity and weather damage. Table 5 contains the amount fo cottonseed meal and corn required to supplement different quality forages when forage is fed free-choice.

TABLE 5. DAILY COTTONSEED MEAL (41%) AND GROUND SHELLED CORN REQUIRED WITH VARIOUS QUALITY FORAGES

Forage Analysis		Repl. Heifers[1]		Dry Cows[2]		Lactating Cows[3]	
		500 lbs		900 -1000 lbs		900-1000 lbs	
CP %	TDN %	Lbs. CSM	Lbs. Corn	Lbs. CSM	Lbs. Corn	Lbs. CSM	Lbs. Corn
> 11.2	>56	0	2.5	0	0	0	0
	>56	0	2.5	0	0	1	0
9.5-11.1	53-56	0	2.75	0	0.5	1	1
	50-53	0	3.25	0	1	1	2.5
	54-56	0.5	2.25	0	0.5	2	0
8.2-9.5	51-54	0.5	2.5	0	1	2	1.5
	>50	0.5	3	0	2	2	2.5
	53-55	1	2.5	0	0.5	2.5	0.5
7.3-8.2	51-53	1	2.75	0	1	2.5	1
	>50	1	3.25	0	2	2.5	2
7.3	>48	1.5-2.0	2.-5.	1	2	3	3

[1]Heifers should gain 1.25 lbs./day at this rate of supplementation.
[2]Dry cows in the lat one-third of pregnancy.
[3]Superior milking cows in the first three months of lactation.

Oil seed meals or a combination of meal and ground corn can be hand fed daily. A common way to self-feed SBM or CSM as a protein supplement for cows is in salt-limited mixtures sometimes called “hot meal” Cattle on dry forage, such as fall grasses or hay will consume up to about 0.1 pounds of body weight each day when it is mixed with a palatable feed. A 900 pound cow, for example, will limit her consumption to salt to about 0.9 pounds per day.

For example, in Table 4, a 900 to 1000 pound lactating cow fed hay than contains 9.0 percent CP and 52 percent TDN needs two pounds of cottonseed meal and 1.5 pounds of corn per day. A salt-limited feed for a 900 pound cow in this case should contain a ratio of two pounds CSM: 1.5 pounds corn: 0.9 pounds of salt. Figure the percentage of each ingredient as follows:

2 lbs. CSM + 1.5 lbs. Corn + 0.9 lbs. Salt =
4.4 lbs. Total daily

2 lbs. CSM x 100% = 45% CSM
4.4 lbs. Total

1.5 lbs. Corn x 100% = 34% Corn
4.4 lbs.

0.9 lbs. Salt x 100% = 21% Salt
4.4 lbs.

Whole Cotton Seed

Cottonseed can be bought in the fall at cotton gins in some areas of Georgia. The price of cottonseed varies greatly from year to year and location to location. In addition to containing protein, cottonseed also contains about 18 percent oil. Due to the high oil content cottonseed is and excellent energy source.

One pound of whole cottonseed has the same amount of protein and energy as a mixture of 0.35 pounds of cottonseed meal and 0.8 pounds of corn.

For cows on low quality grass or grass hay, it is typical to feed two to three pounds of cottonseed per day to dry cows and four to five pounds to lactating cows. A forage analysis will allow for a better estimate of the true need.

The high oil content can cause problems. Cottonseed is difficult to grind and does not mix well for salt-limited feedings. Over-consumption can cause diarrhea; therefore limit intake to a maximum for six pounds per day for mature cows and four to five pounds per day for yearling cattle.

It is easiest to feed cottonseed whole. Grinding it does not improve digestibility. Hand feed cottonseed daily. Cottonseed can be fed on the ground since cattle pick them up well. However, feeding in a trough, will minimize waste, particularly in damp weather. Allow at least two feed of trough space per head.
Store cottonseed in a dry place off the ground. Avoid feeding moldy seed.

Soybeans

Whole soybeans are usually too expensive to use as a cattle feed, but damaged beans are sometimes available. They can be used to replace all of the protein supplement in a complete ration. Follow a few precautions when feeding raw soybeans.

Raw soybeans contain the enzyme urease. If raw soybeans are fed in combination with urea, the urea may be broken down rapidly resulting in urea toxicity. Remove all liquid supplement, protein

blocks, cubes or mixed feed that contain urea before cattle are fed raw soybeans. Due to the heat used in processing this is not a problem with soybean meal.

Raw soybeans contain about 20 percent oil. Like whole cottonseed, the intake of soybeans should be limited to not more than five to six pounds per day for mature cows and four to five pounds for yearling cattle. Coarsely grind or roll soybeans before feeding. Since soybean oil can turn rancid after grinding, it is best to grind small batches that can be fed in two to three weeks.

WINTER GRAZING CROPS

Winter annuals such as oats, rye, wheat and ryegrass are high in energy and protein. When properly managed they range from 17 to 22 percent CP and 70 to 75 percent digestibility (dry matter basis). Establishment of winter grazing is expensive, however limited grazing is an economical supplement for low quality forages. With free-choice hay or other low quality forage a cow can meet her energy and protein needs by grazing tow to four hours per day. Limiting the time that scows are on the grazing decreases trampling and reduces the amount of grazing required per cow.

Rye will usually produce more total forage than other winter annuals. Rye can be planted earlier in the fall it is more drought and cold tolerant than other small grains. Wheat and oats produce forage later in the spring than rye, but they are not as winter hardy. Ryegrass produces most of its growth in late winter and spring as do arrowleaf and crimson clover. Due to the different growth characteristics of these winter annuals, mixtures are often planted. For more information on seeding rates and management of annuals at your location, see Winter Annual Forage Crops (Circular 645).

SUMMARY

Purchased feed represent a major cost in beef cattle production. There are several types of supplemental feeds available for beef cows and prices on these feeds vary a great deal. There are several ways to reduce the cost of your feeding program. An analysis of available forages will allow for proper balancing of the ration and can prevent overfeeding. Group your cattle and feed according to need. Purchase supplements based on price per unit of protein or energy. You must also consider the cost of labor and additional processing. With self-feed supplements, adequate forage needs to be available to prevent over-consumption of supplements, thus increasing cost. For more information contact your local county Extension Agent.

MINERAL SUPPLEMENTS FOR BEEF CATTLE

Choosing a mineral supplement is often a haphazard operation, but the proper information can help you make the correct choice. High-quality forages and/or grains furnish a large portion of the required minerals. Minerals not provided by feed can be easily and inexpensively supplied with simple mineral supplements. This bulletin provides information on basic mineral nutrition for most forage and feeding programs in Georgia. If you encounter specific problems or use specialized feeding programs, mineral supplementation may be necessary.
To supply sufficient minerals in the diet, you need to know the mineral content of various forages and grains and the mineral requirements of your cattle (Table 1).

Functions and Sources of Minerals

Minerals are solid, crystalline chemical elements that cannot be de-composed or synthesized by ordinary chemical reactions. Minerals essential to cattle nutrition are classified as major minerals or trace minerals, depending on whether they are found at levels greater than or less than 100 parts per million (ppm) in the animal's body.

The major minerals are calcium (Ca), phosphorus (P), chlorine (Cl), sodium (Na), magnesium (Mg), potassium (K) and sulfur (S). The trace minerals are cobalt (Co), copper (Cu), iron (Fe), iodine (I), manganese (Mn), molybdenum (Mo), selenium (Se) and zinc (Zn).

Major Minerals

Calcium and phosphorus are the major mineral components of the skeleton. Ninety-nine percent of the total body calcium and 80 percent of the total body phosphorus is stored in the bones. The skeleton reserves calcium and phosphorus to meet short-term dietary requirements. Long-term deficiencies of either can cause bones to weaken and even break.

Calcium and phosphorus also play important roles in other bodily functions. A decrease in either or both can cause a decrease in weight gain and/or a decrease in efficiency of gain. During lactation, low amounts of either will cause reduced milk production. A superior milking cow requires three times more calcium than does a non-lactating cow. A phosphorus deficiency can delay puberty in heifers and can delay mature beef cows in returning to heat after giving birth. Beef cows need correct amounts of calcium for the nervous and muscular systems to function properly.

Proper utilization of calcium and phosphorus is affected not only by the **amount** of each mineral fed, but also by their **ratio**. The optimum Ca:P ratio is about 1.5:1, with a range of 1:1 to 2:1 being satisfactory. In some high-concentrate rations, ratios higher than 2:1 have been successful.

Most forages are high in calcium. Legumes, particularly alfalfa, are often very high in calcium. Peanut, clover and soybean hay are good sources of calcium, but corn silage and sorghum silage are poor sources of calcium. In general, most concentrates are relatively poor calcium sources. Corn and milo are particularly low in calcium content, so cattle fed rations high in grains or corn silage will need calcium supplementation.

Most forages are low in phosphorus, particularly late in the growing season, so cattle fed diets high in forage are more likely to be deficient in phosphorus than in calcium. Cattle are more likely to be phosphorus-deficient during the winter, when they often subsist on dry forages. Concentrates are generally high in phosphorus content, particularly those high in protein. Cottonseed meal is particularly high in phosphorus content. Table 2 gives the average calcium and phosphorus content of some common feeds.

Sodium and chlorine, components of salt, provide for the proper function of the nervous and muscular systems. They help regulate body pH and the amount of water retained in the body. A deficiency of these elements causes loss of appetite and inefficient weight gains or body weight loss.

Sodium is commonly deficient in the ordinary diet of animals, but chlorine levels are usually adequate. Both minerals are present in soft tissues and fluids and there is very little storage of these elements, so you should provide a constant, daily source of sodium and chlorine in the form of common salt or trace mineralized salt. Cattle will voluntarily consume more salt when forage is young and succulent than when it matures. Silage-fed cattle will consume more salt than those fed hay, and consumption is higher in cattle on high-roughage diets than in those on high-concentrate diets. As a rule of thumb, cattle consume 0.005 to 0.010 percent of their body weight in salt daily. A mature cow weighing about 1,000 pounds would need between 0.05 and 0.10 pounds (1,000 x 0.00005 = 0.1), or 0.8 to 1.6 ounces of salt daily.

Magnesium is essential for proper enzyme and nervous system functions and for efficient carbohydrate metabolism. A magnesium deficiency is uncommon except in cows feeding on lush-growth fescue or small grain pastures during the late winter and early spring. A high rate of nitrogen fertilization seems to contribute to grass tetany (wheat pasture poisoning). This condition is caused by abnormal metabolism of magnesium and calcium in cattle grazing on this lush growth. Lactating cows are particularly susceptible to grass tetany.

Grass tetany can usually be prevented by feeding cattle a mixture containing magnesium oxide. Consumption of to two ounces of magnesium oxide daily in the mineral mix should protect high-risk animals feeding on lush-growth fescue or small grain pastures. A mineral mixture containing 14 percent magnesium should provide the proper level of magnesium.

Animals seriously affected by grass tetany respond almost immediately to an intravenous infusion of calcium-magnesium gluconate.

Several other minerals aid in bodily functions. Potassium helps regulate body pH and the amount of water retained in the body. Sulfur forms a part of some amino acids, which make up protein. Deficiencies of sulfur or potassium in beef cattle are not likely to occur under normal feeding conditions, although sulfur levels tend to be low in the soils of the Coastal Plain of Georgia. Animals may benefit from supplemental sulfur if urea is fed as a major source of nitrogen for rumen protein synthesis.

Trace Minerals

Localized areas of Georgia show deficiencies of phosphorus and certain trace elements. If your soils are deficient in these trace minerals, supplementation is advised.

Iron and copper are necessary for the formation of hemoglobin, and copper is also necessary for the absorption of iron. Manganese is an important component of reproduction and fetal and udder development. Selenium is necessary for vitamin E to function properly, and low levels of selenium have been cited as a cause of retained placentas in cows. Cobalt aids in the formation of vitamin B in the animal body.

Of the nine trace elements essential to beef cattle nutrition, only two -- copper and selenium -- are likely to be deficient in beef cattle rations. Copper can be deficient in the Coastal Plain of Georgia. High levels of molybdenum in the diet interfere with copper metabolism and can result in copper requirements three to five times higher than normal.

Selenium can be deficient in some areas of Georgia. Selenium deficiency shows up as white muscle disease (similar to muscular dystrophy) in newborn calves. Selenium is added to mineral mixtures in the form of sodium selenite or sodium selenate. Selenium is very toxic, and should be used in a premixed form only. If a good, thorough feed mixer is not available, do not add selenium to your mineral mix. The FDA has only recently approved the incorporation of up to 0.1 ppm selenium into beef cattle diets; however, 2 ppm selenium has produced no toxic signs, and this

concentration is suggested as a maximum tolerable level.

Trace mineralized salt contains all of the trace minerals except selenium and molybdenum. Do not add molybdenum to livestock rations in Georgia.

TABLE 1. MINERAL REQUIREMENTS AND MAXIMUM TOLERABLE LEVELS FOR BEEF CATTLE

	Requirement		Maximum
Mineral	Suggested Value	Range[α]	Tolerable Level[α]
Calcium, %	----	.15 to 1.0	2
Cobalt, ppm	0.1	0.07 to 0.11	5
Copper, ppm	8	4.0 - 10.0	115
Iodine, ppm	0.5	0.20 - 2.0	50
Iron, ppm	50	50.0 - 100.0	1000
Magnesium, %	0.1	0.05 - 0.25	0.4
Manganese, ppm	40	20.0 - 50.0	1000
Molybdenum, ppm	----	----	6
Phosphorus, %	----	0.17 to 0.47	1
Potassium, %	0.65	0.5 to 0.7	3
Selenium, ppm	0.2	0.05 to 0.30	2
Sodium, %	0.08	0.06 to 0.10	----
Sulfur, %	0.1	0.08 to 0.15	0.4
Zinc, ppm	30	20.0 to 40.0	500

[a]The listing of a range in which requirements are likely to be met recognizes that requirements for most minerals are affected by a variety of dietary and animal factors. It might be better to evaluate rations based on a range of mineral requirements and for content of interfering substances than to meet a specific dietary value.

[b]NRC, 1984. Adapted from NRC. *Nutrient Requirements of Beef Cattle, Sixth Edition.*

TABLE 2. CALCIUM AND PHOSPHORUS CONTENT OF SOME COMMON FEEDS (DRY MATTER BASIS)

Feedstuffs	Calcium %	Phosphorus %
Dry roughages		
Alfalfa hay, mid-bloom	1.2	0.2
Alfalfa hay, early bloom	1.12	0.21
Bermudagrass hay	0.42	0.18
Bluegrass hay	0.44	0.26
Corncobs	0.11	0.04
Cornstover	0.43	0.08
Cottonseed hulls	0.14	0.09
Fescue hay	0.44	0.32
Grass-clover hay 65%-35%	0.78	0.27
Lespedeza hay, mid-bloom	1.11	0.24
Oat hay, mature	0.23	0.21
Orchardgrass hay	0.4	0.33
Red clover hay	1.41	0.19
Straw, wheat	0.15	0.07
Sorghum	0.5	0.28
Timothy hay, early bloom	0.53	0.23
Silages		
Alfalfa, not wilted	0.49	0.12
Alfalfa, wilted	0.51	0.12
Corn, dent mature, well-eared	0.11	0.08
Grass-legume	0.45	0.1
Sorghum, grain variety	0.07	0.05
Sorghum, sudangrass	0.1	0.05
Concentrates		
Barley	0.08	0.42
Cane molasses	0.89	0.08
Corn, dent No. 2	0.02	0.31
Corn distillers solubles	0.35	1.37
Cows milk	0.11	0.08
Cottonseed, meal	0.16	1.2
Cottonseed, whole	0.14	0.68
Dehydrated alfalfa	1.33	0.24
Ground ear corn	0.04	0.27
Milo	0.04	0.29
Oats	0.1	0.35

Soybean meal	0.32	0.67
Wheat	0.05	0.36
Mineral Sources		
Dicalcium phosphate	22.2	17
Deflourinated rock phosphate	33	18
Ground limestone	33.8	----
Sodium tripolyphosphate	---	24.9
Steamed bone meal	29	13.6

Meeting Mineral Requirements

Common Ingredients

Many mineral ingredients can be used to supplement mineral-deficient beef cattle rations. Those mineral ingredients listed in Table 3 are generally recognized as safe by the Food and Drug Administration when they are used in proper proportions.

Table 3. Mineral Ingredients on the Food and Drug Administration GRAS List[a]

Calcium chloride	Reduced iron
Calcium gluconate	Magnesium carbonate
Calcium hydroxide	Magnesium oxide
Calcium iodate	Magnesium sulfate
Calcium iodobehenate	Manganese acetate
Calcium oxide	Manganese carbonate
Calcium sulfate (anhydrous)	Manganese chloride
Calcium sulfate (dihydrate)	Manganese citrate (soluble)
Cobalt acetate	Manganese gluconate
Cobalt carbonate	Manganese orthophosphate
Cobalt chloride	Manganese oxide
Cobalt oxide	Manganese phosphate (dibasic)
Cobalt sulfate	Manganese sulfate
Copper carbonate	Monocalcium phosphate
Copper chloride	Monosodium phosphate
Copper gluconate	Potassium bicarbonate
Copper hydroxide	Potassium carbonate
Copper orthophosphate	Potassium chloride
Copper oxide	Potassium iodate
Copper pyrophosphate	Potassium iodide
Copper sulfate	Potassium sulfate
Cuprous iodide	Sodium chloride
Dicalcium phosphate	Sodium bicarbonate
Diiodosalicylic acid	Sodium iodate
Disodium phosphate	Sodium iodide
Ethylenediamine dihydroiodide	Sodium sulfate
Ferrous fumarate	Sodium tripolyphosphate
Iron ammonium citrate	Sulfur
Iron carbonate	Thymol iodide
Iron chloride	Tricalcium phosphate
Iron gluconate	Zinc acetate
Iron oxide	Zinc carbonate
Iron phosphate	Zinc chloride
Iron pyrophosphate	Zinc oxide
Iron sulfate	Zinc sulfate

[a]GRAS = generally recognized as safe; these ingredients are recognized as safe when used as feed ingredients under controlled conditions.

Mixing Minerals

The amounts of certain minerals to be added to the ration are generally accepted as the difference between the level in the available feedstuffs and the National Research Council (NRC) level requirements. Frequently in the case of trace minerals, anywhere from 50 to 100 percent of the NRC requirements will be added because of the tremendous variability in trace mineral composition of feeds and the high cost of obtaining accurate trace mineral levels. If a particular trace mineral is known to be low in your area, you might need to provide 100 percent of the requirement. Your county agent has information concerning mineral deficiencies in your county.

The most satisfactory way of providing supplemental minerals to grazing animals is a complete mineral mix offered free-choice in mineral feeders. The system requires excellent management. Keep the minerals clean, fresh and available, and observe consumption to determine if cows are eating reasonable amounts.

All-Purpose Mineral Mix

Unless your cattle operation is large enough to warrant preparing your own mineral mixture, commercial mixtures can be more economical. Commercial mineral mixes should contain approximately nine to 12 percent calcium and six to nine percent phosphorus. The salt content generally ranges from 18 to 25 percent.

A good, basic mineral mixture for cattle grazing/consuming hay or silage contains about one-third to one-half salt or trace mineralized salt and one-half to two-thirds of a feed grade calcium phosphate (usually defluorinated or dicalcium phosphate). Usually a half-and-half mixture will work reasonably well. Feed this mixture free-choice. Use trace mineralized salt if a deficiency of any trace minerals is suspected. Marginal, undetected deficiencies can occur in cattle, even when there is no indication of a soil deficiency. Trace mineralized salt is not expensive and is good insurance against trace mineral deficiencies.

Grass Tetany Mineral

During late winter and early spring most producers in Georgia are concerned about grass tetany, which is caused by an improper balance of magnesium and calcium metabolism. The condition can be controlled by adding magnesium oxide to the mineral mix. About 25 grams of magnesium daily should provide protection against grass tetany. About half of the daily intake will come from the feed and half from the magnesium-containing mineral mix. The following is a good basic magnesium-based mineral mix:

30% trace mineralized salt

30% dicalcium or defluorinated phosphate

30% magnesium oxide

10% cottonseed meal or soybean oil meal

A mature cow will usually consume two to four ounces (60 to 120 grams) of a mineral mix daily. Using this assumption, a mature cow will receive 0.6 to 1.2 ounces (18 to 36 grams) of magnesium oxide daily. Magnesium oxide is about 60 percent magnesium, so the cow will receive 0.4 to 0.7 ounce (11 to 22 grams) of magnesium daily from the mineral mix. In most situations this should control grass tetany. When you use this mineral mix, remove all other salt from the cattle's diet, because the cattle are consuming the mix for the available salt.

Commercial mixes that are effective in preventing grass tetany are avail-able. Commonly called high-mag blocks or mixes, these minerals should contain 11 to 13 percent magnesium. For the small cattleman, it may be more practical to purchase a high-mag mineral than to mix individual ingredients.

High-mag minerals are necessary only during high-risk situations. The chance of grass tetany is greatest under warm, rainy conditions during the fall and early spring. Forages most likely to produce tetany are winter annuals and well managed fescue. Offer the high-mag mineral when these conditions exist. However, there is no advantage in using high-mag minerals during the rest of the year.

Minerals for Concentrate Rations

Cattle on high-concentrate diets should have the salt and minerals mixed in as an integral part of the ration. Salt is usually fed at 0.25 to 0.5 percent of the total ration, with five to 10 pounds of salt mixed with a ton of feed. Calcium and phosphorus are usually added as needed to balance the ration. Grains such as corn and wheat and oilseed meals such as soybean meal and cottonseed meal contain low amounts of calcium and high amounts of phosphorus. Therefore, mineral supplements for grain mixes will differ from those for pasture. If salt and minerals are not added to the ration, the following mineral supplement is recommended:

1 part trace mineralized salt

1 part defluorinated phosphate, dicalcium phosphate or steamed bone meal

1 part ground limestone

Calcium is less expensive than phosphorus, so many commercial mineral supplements are higher in calcium than is recommended for cattle on pasture. The cost might be lower but the mix might not do the job. No magic formulas or sources of minerals warrant paying a high price for a mineral

you could mix at a lower price.

Balancing the Mineral Requirements

The difference between the requirements for a particular class of cattle and what they are receiving needs to be made up for by mineral supplements. Many commercial mineral mixes are available for various uses. Be sure to purchase a mineral mix that supplies the deficient minerals.

Tables of NRC requirements for various classes of beef cattle will help you to balance the requirements for calcium and phosphorus. The requirements have no safety factors for stress or availability of minerals for absorption. Remember, all cattle need supplemental salt, phosphorus is most likely to be the deficient mineral in cattle on pasture, and calcium is most likely to be the deficient mineral in feedlot cattle. Knowing the deficient mineral saves you money and makes your cattle perform better.

Mineral Feeders

The placement of mineral feeders is a very important part of supplying minerals to the cow herd. Be sure an adequate number of feeders is available for the stocking rate of the pasture. The best areas to place mineral feeders are near water, in shaded loafing areas and near the best grazing areas. Check feeders at least once a week and keep a clean, fresh supply of minerals present at all times. Because minerals can be corrosive to metals, wood or fiberglass mineral feeders usually last longer. Permanent mineral feeders of concrete also work well.

Vitamins

Vitamins are closely linked to mineral metabolism and absorption. Vitamin A helps skin and mucous membranes stay healthy and free from infection. Vitamin A requirements usually are met by grazing fresh, green, growing grass. Oxidation deteriorates vitamin A during storage. Supplement rations with vitamin A any time the major portion is stored feeds.

Vitamin A can be added to a mineral mix in a stabilized form to prevent oxidation. The minimum amount should be approximately 120,000 Inter-national Units (IU) of vitamin A per pound of mineral. Vitamin A can also be added to the grain mixture to provide 15,000 to 30,000 IU per head per day, depending on individual requirements. An alternative method is to inject 1.5 million IU subcutaneously if a source of dietary vitamin A is not available for 60 to 90 days.

Vitamin D aids the absorption of calcium and phosphorus from the intestine and their deposition in the bone matrix. Signs of vitamin D deficiency are similar to a calcium or phosphorus deficiency. Most cattle exposed to direct sunlight synthesize enough vitamin D, but cattle in a confinement feedlot may need supplemental vitamin D.

Vitamin E is usually present in sufficient quantities in the diet for all classes of cattle; however, a selenium deficiency could lead to an apparent deficiency of vitamin E. Vitamin E is not usually

added to feed or mineral mixtures.
Other essential vitamins are usually present in adequate quantities in the diet or are synthesized in the rumen.

Summary

Mineral nutrition is important because cattle perform better and more efficiently when fed an adequate diet of minerals. Calcium and phosphorus are most likely to be the limited minerals in cattle rations. Magnesium may be a problem during late winter or early spring, especially in mature lactating cows. Adding mineral supplements to the ration is relatively inexpensive and the results are very rewarding.

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Use of Alternate Feeds for Beef Cattle

Introduction Livestock producers frequently seek less costly feed alternatives because conventional feedstuffs are often expensive. During periods of drought and feed shortages, these feed alternatives may make the difference between keeping your beef herd or selling them. Although alternate feeds are used routinely, others depend on the location and situation.

Consider alternate feeds in cattle feeding programs, such as by-products of crop processing, waste products and crop residues. These materials are often overlooked as potential feedstuffs. Alternate feeds can fit into a feeding program as the primary forage, as a supplement to a routine ration or as a replacement for a part of the ration.

Extensive research has been conducted on the usefulness of alternate feeds for beef cattle. These studies indicate that alternate feeds can be used effectively in any feeding program for beef cattle. Consider the availability, nutrient content, economics and special equipment requirements before using an alternative feed. These factors will vary depending on location and time of year.

Availability of By-Products

The availability of specific alternate feedstuffs is different for each part of the state; however, in every region, some type of residue or by-product is obtainable. Brewer's grains, for example are readily accessible if your farm is located near a brewery, but crop residues such as wheat straw, corn stalks and milo stalks are available in almost all areas of the state.

Consider the mechanics and economics of buying, transporting, storing and handling alternate feeds before using them in your feeding program. Some by-products are available only at certain times of the year. They must be bought through contracts and delivered at times specified by the seller (for example, processed by-products or waste products which companies must dispose of regularly). Other by-products are seasonal which require producers to know long-range feed needs and have the capability to handle and store large quantities of feed. Feeds in this category can usually only be used advantageously by large producers. Another factor favoring large scale usage of some feeds is that they require specialized equipment to process and mix rations containing these by-products. If specialized equipment such as front-end loaders and mixer wagons are required, then large numbers of cattle must be fed to justify the equipment's depreciation.

Finally, determine availability by the cost of transportation of the feedstuff from starting point to a producer's farm. Many feedstuffs will be economical to use even when transportation costs are added. However, high moisture by-products or bulky high moisture roughage feeds might not be a good buy after trucking costs are added.

Nutrient Composition

Test the nutrient composition of these feeds before you purchase and feed them. Your county Extension agent can take feed samples and send them to the Soil Testing and Plant Analysis Lab to determine nutrient composition. Average or typical nutrient compositions of many alternate

feedstuffs are presented on a dry matter basis in Table 1 (use these values only as a guideline). Many of these feedstuffs will have varying nutrient levels due to processing or harvesting method, weather, management and maturity. Feeds other than those in Table 1 may be available in certain areas and can be used effectively in those areas. Before rations or supplementation programs can be used effectively in those areas. Before rations or supplementation programs can be accurately prepared, know the actual nutrient composition. Most of these by-products will have very low or non-existent vitamin content and rations including these should have vitamins A,D, and E supplemented. Whether an alternative feed is routinely used or is a new by-product, have a sample tested in order to be sure of its value.

Table 1. Nutrient Composition of By-Product Feeds

Feed	Percent of Dry Matter[a]						
	DM	CP	TDN	CF	Ca	P	Ash
Energy Feeds							
Apple Pomace	28.0	6.0	73.0	27.0	0.10	0.10	2.0
Citrus Pulp	90.0	6.5	80.0	13.0	1.90	0.13	6.0
Soy Hulls	91.0	12.0	80.0	39.0	0.60	0.17	4.0
Hominy Feed	91.0	11.5	92.0	7.0	0.06	0.58	3.1
Protein Feeds							
Brewer's Grain	24.0	26.0	81.0	15.0	0.30	0.57	5.0
Caged Layer Waste	30.0	28.0	52.0	16.0	8.80	2.50	28.0
Corn Gluten Feed	90.0	26.0	83.0	10.0	0.50	0.86	7.0
Cottonseed (whole)	93.0	22.0	89.0	20.0	0.20	0.73	4.0
Distillers Dried Grains	92.0	27.0	82.0	12.0	0.10	1.00	2.0
Peanut Skins	92.0	17.6	65.0	13.0	0.20	0.20	2.7
Thin Stillage	8.0	27.0	82.0	12.0	0.10	1.00	2.0
Roughages							
Corn Stalks	85.0	6.6	50.0	34.0	0.50	0.10	7.2
Cotton Gin Trash	92.0	6.0	44.0	38.0	0.60	0.20	10.0
Cottonseed Hulls	91.0	4.1	45.0	48.0	0.10	0.07	2.8
Milo Stalks	85.0	5.6	54.0	33.0	0.40	0.10	10.0
Peanut Hay	91.0	10.8	48.0	33.0	1.20	0.15	8.6
Peanut Hulls	91.0	8.5	22.0	63.0	0.20	0.07	4.0
Soybean Stubble	88.0	5.0	40.0	44.3	1.00	0.06	6.4
Wheat Straw	92.0	4.1	40.0	42.0	0.17	0.04	10.0

[a]DM=dry matter; CP=crude protein; TDN=total digestible nutrients; Ca=Calcium; P=phosphorus

Pricing By-Products

If you are informed on the correct nutrient composition of a feed, it will allow you to use the feed correctly and accurately estimate the value of the unknown feed versus standard feeds. Decide what the by-product will provide; energy, protein or roughage. Before buying feed, take a little time to look at cost versus value. Some feeds have a cost much above their nutritional value and others have a higher value than they actually cost.

Determining the actual value based on all nutrients can be very complicated. However, an approximate value can be calculated simply by using only two nutrients - energy and protein. Although other nutrients are vital in balancing a ration, energy and protein represent the largest percent of the ration; therefore, their price largely determines the total cost of a ration. If a producer is only interested in energy or protein, it would be a simple matter of comparing by-products to corn or soybean meal for a single nutrient.

Table 2 contains a list of by-products, residues and waste products accessible to cattlemen in Georgia. The value for each feed is estimated on an as-fed (fresh) basis determined by considering both their energy and protein content. Because corn and soybean meal are the most available sources of energy and protein, they were used as a base to set the value of the other feeds. Soybean meal (44% protein) was assigned a value of $200/ton. This value was held constant. Two prices for corn were assigned; $2.50/bushel and $3.00/bushel. Using these figures, the value of the other feeds were determined.

The information in the table is useful, but there are not considerations for palatability, handling, storage or maximum percent that can be used in a ration. Comparisons are valid if made within a group (energy, protein or roughage).

Use these estimated values only as guidelines. The actual value to a specific farmer will change with the nutrient content of your sample, the actual cost of corn (or other energy supplement) and soybean meal (or other protein supplement).

Apply rules for good nutrition and ration balancing after you have identified the most economical alternate feeds. Georgia Extension Service Bulletin B-907, "Balancing Rations for Beef Cattle," will be helpful.

TABLE 2. ESTIMATED VALUE OF ALTERNATE FEEDS*

	Value @ $2.50 Corn	Value @ $3.00 Corn
Energy Feeds	**$/ton**	**$/ton**
Apple Pomace	21	26
Citrus Pulp	75	91
Soy Hulls	92	106
Hominy Feed	100	116
Protein Feeds		
Brewer's Grain	35	38
Broiler Litter	99	101
Caged Layer Waste	39	40
Corn Gluten Feed	133	143
Cottonseed (whole)	130	143
Distillers Dried Grains	139	148
Peanut Skins	99	107
Thin Stillage	12	13
Roughages		
Corn Stalks	51	60
Cotton Gin Trash	49	58
Cottonseed Hulls	44	53
Milo Stalks	51	61
Peanut Hay	66	80
Peanut Hulls	40	42
Soybean Stubble	41	49
Wheat Straw	41	49

*Value is estimated based on soybean meal costing $200/ton and corn costing $2.50/bu and $3.00/bu.

Alternate Feeds in Georgia

The following section discusses the advantages and disadvantages of some alternate feeds found in Georgia. Although not discussed for each individual feeds, keep pesticide residues and label restrictions in mind when purchasing feed ingredients. Care must be taken that feeds do not contain significant pesticide residues or the commodity has not been treated with a pesticide that carries the label restriction "do not feed treated hay or stubble to livestock."

APPLE POMACE - is the residual material from pressing apples for juice containing the pulp, peels, and core. Fresh pomace is a high moisture product which spoils rapidly. It is a low protein, high fiber feed which is very digestible. If rice hulls have been added during pressing, dry matter has been increased and energy content has decreased. Major disadvantages are its moisture content and availability only in apple-producing areas.

CITRUS PULP - is formed by shredding, liming, pressing and drying the peel, pulp, and seed residues from citrus fruit. It is another low protein, high fiber feed which is very digestible. Citrus pulp is an excellent feed, but is it rarely economical for beef cattle rations in Georgia.

SOY HULLS - are a by-product of the soybean oil milling process. A high fiber feed which is very digestible, and is higher in protein than either apple pomace or citrus pulp. They are an excellent supplement for forage based rations (grazing, hay or silage). Soy hulls are most effective when limited to 30 percent of the animal's intake. Although they contain a good deal of fiber, soy hulls are not a desirable fiber source in a finishing diet. They are a bulky, dusty feed which works best when mixed with silage or molasses to reduce dust.

HOMINY FEED - Hominy feed contains the corn bran, germ, and some of the starchy portion of the corn kernel resulting from the production of degermed corn meal for human consumption. It is about equal to ground corn in feeding value and is very palatable to livestock. Levels of 50 percent or more of the concentrate mix have been used successfully in cattle rations. In complete feedlot rations, as high as 70 percent has been fed successfully. However, a 10 to 15 percent level is more common. Normally, hominy feed contains 6 percent or more of fat. When part of the fat is removed, the resulting low fat hominy feed is somewhat lower in energy value. However, both forms are good energy sources and have higher protein levels than in the corn grains from which they were produced.

BREWER'S GRAIN - is a by-product of the production of beer which is an excellent source of protein and a good source of energy. It is highly palatable and can be used in a variety of rations. In Georgia, most breweries offer this by-product only in the wet form 70 to 80 percent moisture); therefore, transportation costs are high. Unless stored in trench or bunker silos, the shelf life is limited. The storage and cost of handling usually limit the use of brewer's grain to relatively large cattlemen.

CORN GLUTEN FEED - is a by-product of the corn milling process. It consists primarily of the bran and meal remains from the grain after the starch is removed. The protein content is good (26 percent), but protein quality is low making corn gluten feed unattractive for swine or poultry rations. Corn gluten is not produced in Georgia; however, consider it as a protein and energy

supplement because it is frequently cheaper than other feeds.

COTTONSEED (WHOLE) - is an excellent source of both energy and protein and readily available in cotton-producing areas. In many years, cottonseed is economically feasible to allow for considerable trucking costs. Levels included in stocker or finishing rations should not exceed 20 percent of the ration. For brood cow supplements, the level fed should not be greater than approximately five lbs./head/day.

DISTILLERS GRAIN AND THIN STILLAGE - are two by-products from the fermentation of grain to produce alcohol. Distillers grains primarily contain unfermented grain residues (protein, fiber, fat). Thin stillage contains yeast cells, soluble nutrients and very small corn particles. Drying distillers grain during processing facilitates storage, transportation and handling. Thin stillage is sold as a high moisture product or it can be concentrated to a molasses-like consistency. Both feeds are excellent sources of protein and energy. Protein content primarily determines their value. In growing and finishing cattle rations, use a mix of distillers grain (95 percent) and urea (five percent) to replace soybean meal. The greatest disadvantage of both feeds is their availability which is normally confined to areas around distilleries and ethanol plants. Thin stillage also is more difficult to use because of its consistency.

PEANUT SKINS - are the result of "blanching," or removal, of the skin from the peanut kernel. Although they contain moderate levels of protein and energy, peanut skins have limited potential in beef rations. The skins contain a high amount of tannin which can greatly reduce the digestibility of protein. Current research indicates that peanut skins should make up no more than approximately 10 percent of ration dry matter.

CORN STALKS, MILO STALKS, WHEAT STRAW AND SOYBEAN STUBBLE - are the stem and leaf materials which remain after grain has been harvested. Because of their low nutrient content, these crop residues are utilized as forages in special situations. Their best uses appear to be:

- **Grazing** - Corn fields and milo fields provide good forages for cattle in the fall of the year. If used before heavy winter rains, these fields can provide up to 30 cow-grazing days per acre.

- **Hay** - These residues can be harvested for hay. Their nutrient content is low; however, the amount of dry forage which can be baled makes them attractive during periods of drought. Research has shown that the quality of corn stalks and wheat straw is greatly improved when treated with anhydrous ammonia. Your county Extension agent will have details.

Note: When feeding or grazing soybean stubble, do *not* offer a supplement containing urea. The combination of urea plus raw soybeans can cause sickness or death.

COTTON GIN TRASH - is a by-product of the cotton ginning process. It contains boll residues, leaves, stems, and lint. This composition makes it a very bulky, unpalatable, high fiber, low energy feed. Its only practical use is in hay-replacer rations when mixing it with another feed is more economical than buying hay. Generally, it is a very inexpensive feed with limited uses. Reducing the particle size by grinding makes it easier to handle and will improve intake.

COTTONSEED HULLS - are a high-fiber, low-protein by-product of the cotton industry. They are high in crude fiber which is not very digestible, but are more palatable than many other sources of fiber. Hulls are a very bulky feed which possess excellent mixing qualities in concentrate ration at low levels. On a practical basis, they should only be used as a roughage source at low levels (10 to 25%) for growing and finishing cattle. They will work well in hay-replacer rations for brood cows if they are cost effective.

PEANUT HAY - consists of the vines and leaves of the peanut plant after the peanuts have been combined. Protein content of peanut hay is fair to good, while energy content is low. The coarse nature of peanut hay will result in a high degree of spoilage unless protected from rain. Peanut hay can be utilized as the primary forage in a feeding program when properly supplemented.

PEANUT HULLS - are the by-product of the peanut shelling process. High in fiber, low in energy and protein, peanut hulls can be used to provide the needed fiber in finishing rations. They can also be used as an extender in stocker rations and hay replacers for brood cows. Peanut hulls are extremely bulky and hard to handle. Availability is good if you are located near a shelling plant.

Summary

In conclusion, many alternate feedstuffs for feeding beef cattle are available in Georgia. As presented in Table 2, many are excellent bargains while others are not. There are probably many more alternate feeds which are available in some places, but were not discussed. Each producer must decide if a specific feed is economical to use and whether it fits a particular farm situation. If these criteria can be met, then alternate feeds should be a beneficial addition to current feeding practices.

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PRICING BY-PRODUCT FEEDS

Many different feedstuffs can be utilized to meet an animal's nutrient requirements. However, all of the available feeds do not meet the nutrient requirements for the same amount of money. In many instances, a producer should first decide what the by-product will provide: energy or protein. Some feeds have a cost much above their nutritional value. Others will have a higher value than they actually cost.

Determining the actual value based on all nutrients can be very complicated. However, an approximate value can be calculated by using only energy or protein. Although other nutrients are vital in balancing a ration, many feeds are evaluated only as a protein or energy feed. However, with the use of simultaneous equations, value can be calculated on the basis of both energy and protein. Energy and protein together represent the largest percent of ration. Therefore, their price largely determines the total cost of a ration.

Since corn and soybean meal are generally considered standard feeds, they will be used in the examples.

Since corn and soybean meal are generally considered standard feeds, they will be used in examples.

Example 1: Price comparisons for a single nutrient should utilize TDN for energy and CP for protein. All values for feeds should be expressed on an as-fed basis, since moisture content varies and feed will be purchased on a per ton basis. So the first step is to convert the nutrient composition of standard and by-product feed from DM basis to an a-fed basis.

A x B = As-fed nutrient composition

where A = Dry matter of feed
B = Individual nutrient composition on DM basis

	DM%	TDN%
Brewer's grain	24	72 (on DM basis)

(.24) x 72% = 17.28% TDN on as-fed basis

The only remaining information needed is the prices of standard feed used. For this example ground corn delivered to farm at $108/ton and 44% SBM at $232/ton.

Value of by-product = TDN or CP of by-product x Price of Standard ($/ton)

($/Ton) TDN or CP of standard

Question: Value of broiler litter as protein supplement vs. SBM

Step 1 - convert litter and SBM values to as-fed

		DM	CP
Dry matter basis	litter	78	26
	SBM	89	49.4

As-fed basis litter (.78) x 26% = 20.3%
SBM (.89) x 49.4% = 44%

Step 2 - Calculate value of litter

$$\frac{20.3\%}{} \times \$232 = \text{value}$$

.46% x $232 = $106.72/ton of litter

Question: Value of soyhulls as energy supplement vs. corn

Step 1 - convert soyhulls and corn values to as-fed

		DM	TDN
Dry matter basis	soyhulls	91	72
	corn	88	89

As-fed basis soyhulls (.91) x 72% = 65.5%
corn (.88) x 89% = 78.3%

Step 2 - calculate value of soyhulls

$$\frac{65.5\%}{78.3\%} \times \$108 = \text{value}$$

.84 x $108 = $90.72/ton or soyhulls

Both steps can be added together to form one equation.

By-product $\frac{\text{(DM) (TDN) or (CP)}}{\text{(DM (TDN) or (CP)}} \times$ prices of standard = value of by-product

Example 2: Price comparisons for two nutrients should utilize TDN and CP. As in first example, all feeds should be evaluated on an as-fed basis. Simultaneous equations can be used to estimate feed value of a by-product in relation to corn and SBM.

Step 1: Use as-fed values for corn, SBM, and by-product.

	CP	TDN
SBM	44	75
Corn	8.8	78
Brewer's Grain	6.24	17.28

Step 2: Solve simultaneous equations with X representing the value of each % protein and Y representing the value of each % TDN.

SBM: % CP (X) + % TDN (Y) = $/ton

Corn: % CP (X) + % TDN (Y) = $/ton

Actual EQ: 44 (X) + 75 (Y) = 232
8.8 (X) + 78 (Y) - 108

Multiply bottom EQ X (44/8.8)

44 (X) + 75 = 232
5 8.8 (X) = 78 (Y) = 108

44 (X) + 75 (Y) = 232
-44 (X) -390 (Y) = -540
-315 (Y) = -308
(Y) = .98

Take one equation and insert known value for Y and solve for X.

44 (X) + 75 (.98) = 232
44 (X) + 73.50 = 232
44 (X) = 158.50
X = 3.6

Step 3: Plug known values for protein (X) and energy (Y) into equation for By-product.

By-product CP% = by-product TDN% (Y) = Value/ton

For Brewer's Grain

6.24 (3.6) + 17.28 (.98) = Value/ton
22.46 + 16.93 = $39.39/ton

Example 3: Shortcut determination of by-product value

$$\text{Value of each \% TDN} = \frac{[(\$/\text{ton corn}) \times 5] - (\$/\text{ton SBM})}{315}$$

$$\text{Value of each \% CP} = \frac{[(\$/\text{ton SBM}) \times 1.04] - (\$/\text{ton corn})}{37}$$

Using same prices for corn and SBM as in other examples.

TDN $\frac{[(108 \times 5] - 232}{315}$ = $.98 for each % TDN in by-product

CP $\frac{[(232 \times 1.04] - 108}{37}$ = $360 for each % CP in by-product

Values are identical to those derived using simultaneous equations in Example #2.

To check another potential feed.

Example: Whole cottonseed

CP = 20.5 TDN = 82.75 (As-fed)

(% TDN) ($/% TDN) + (% CP) ($/% TDN) = Value/ton

(82.75) (.98) + (20.5) (3.60) = value

(81.1) + (73.80) = $154.90/ton value

Remember, if you have standard feeds other than corn and SBM, their nutrient information and prices can be substituted in the place of corn or SBM in the pricing examples.

STOCKER RATIONS

Robert L. Stewart

Ingredients	1	2	3	4	5	6	7	8	9
Corn Silage	1925	1975	1825						
Sorghum Silage				1785	1750	1795			
Peanut Hulls							800	780	890
Corn				120	220		1070	1185	500
Soybean Meal 44	60			75			110		
Urea		10			10			15	
Whole Cottonseed			160			190			590
Limestone	5	5	5	5	5	5	10	10	10
Dicalcium Phosphate				5	5				
Trace Mineral Salt	10	10	10	10	10	10	10	10	10
	2000	2000	2000	2000	2000	2000	2000	2000	2000

*Rumensin or Bovatec should be added at the rate of approximately 200 mg./hd/day.

*Vitamin A should be added at the rate of 1 million IU per ton for silage based rations and 2 million IU per ton for day rations.

The above rations contain approximately (dry matter basis): 11% Crude Protein, 65% TDN, .40% Calcium, .26% Phosphorus

WHOLE COTTONSEED FOR BEEF CATTLE

Cotton harvest has been in full swing for several weeks and the availability of whole cottonseed (WCS) is at a peak. Many cattlemen will consider feeding WCS as a supplement to hay and in mixed rations for stockers. The number of cattlemen feeding WCS for the first time skyrocketed last year. For the most part, few problems were reported. It appears that WCS will be priced favorably again this year. Consider the following guidelines and you should experience few, if any, problems.

Value of Whole Cottonseed

Whole cottonseed contain approximately 20 percent crude protein, 17 percent fat, 20 percent crude fiber and 90 percent TDN (equal to or more energy than corn). In order to estimate a value for WCS, I compared them to corn and 44% soybean meal. Prices will vary; however, I priced corn at $2.50 per bushel and 44% soybean meal at $200 per ton. According to my calculations, WCS would be worth approximately $125 per ton when compared to corn and soybean meal. If WCS can be bought for less than $125 per ton, you should consider using them as a protein and energy supplement this winter.

In many situations, WCS are fed at levels that more than meet protein requirements. If fed primarily as an energy source, then WCS are worth approximately the same amount as corn. If this is the case, when compared to corn at $2.25 per bushel, then WCS are worth approximately $80 per ton.

Guidelines for Feeding

(1) Feed only whole, non-delinted, untreated seed. These are commonly known as gin-run cottonseed.

(2) Buy only dry seed that are not moldy and store in a dry place. Damaged or moldy seed may contain aflatoxin.

(3) Feed up to 7 lbs./day to mature cows and 3-4 lbs./day for weaned calves. Over- consumption may cause scouring. Do not include WCS in creep feeds. Based on my experience, there are no problems when moderate amounts of WCS are fed to bulls.

(4) It is usually best to feed cottonseed whole. Grinding does not increase digestibility and the lint from the seed may clog the screen.

(5) WCS should be hand-fed. They do not mix well with salt for self feeding.

Rations

Dry Cows: Free-choice hay or stockpiled grass plus 2-3 lbs WCS.

Lactating Cows:

(1) Free-choice grass hay
Plus 5 lbs WCS

(2) Free-choice silage plus
2-3 lbs WCS

Stocker Calves:

(1) Free-choice grass hay (good quality)
Plus 4 lbs WCS

(2) Free-choice silage plus
2-4 lbs WCS

(3)

WCS	600 lbs
Corn	450 lbs
Peanut Hulls	920 lbs
Limestone (feedgrade)	20 lbs
TM Salt	10 lbs
Vit. A	2 mill. I.U.

(4)

Broiler Litter	1200 lbs
WCS	500 lbs
Corn	300 lbs
Vitamin A	2 mill. I.U.

Note: Gains of stockers will be limited by the quality of forage. These rations should result in moderate gains of 1.5 to 1.75 lbs./day. If higher gains are desired, then additional energy should be fed.

Minerals

WCS are an excellent source of phosphorus and contain very little calcium. When feeding WCS, offer a loose mineral containing a 2:1 calcium:phosphorus ratio. An alternative would be to mix equal parts feed-grade limestone with your regular mineral.

Handling

The major disadvantage to feeding WCS is handling. WCS do not auger well; therefore, they will not flow through grain bins. Good results are obtained using a front-end loader, seedfork or scoop. The added labor of handling should be considered before deciding to use WCS.

Storage of WCS can be simple. A commodity-type bin with plywood sides and a floor will work well. Dry seed should not require air-flow if stacked no more than four feed high. Success has been reported when WCS are stored in a side delivery peanut wagon. The wagon can be stored under a shed or covered with a tarp. WCS can be easily bagged using the side door.

WCS may be fed on the ground. Cattle can pick them up well. However, when conditions are wet, WCS should be fed in troughs to minimize waste. Allow two feet of linear trough space per head.

WCS certainly do not fit every cattleman's feeding program. However, if you have the means to handle them, you should consider feeding them this winter.

GUIDELINES FOR USE OF AFLATOXIN CONTAMINATED FEEDSTUFFS IN LIVESTOCK RATIONS

Aflatoxins are only one of many mycotoxins naturally found in feedstuffs. The following recommendations pertain specifically to aflatoxins and may not apply at all to other toxins. Also, these recommendations are designed to be used for on-farm use of contaminated ingredients. Regulations pertaining to the mixing, sale and especially interstate transport of contaminated feedstuffs or mixed rations may overrule the recommendations in this publication. If a question arises, contact the Georgia State Department of Agriculture.

A critical factor in use of aflatoxin contaminated feedstuffs is that the analysis is representative of the true levels found in the feed. The mold which produces aflatoxin may be spread throughout a batch of feedstuff but more often it is concentrated in certain areas of a bin. This means that aflatoxins may be concentrated in certain areas making it difficult to get a representative sample for analysis. Therefore, if the contaminated feedstuff is to be used in livestock rations, the user should be aware of the risks of underestimating the peak levels of aflatoxin.

Another set of factors which greatly affect the possible use of contaminated feedstuffs is the presence of other stresses, diseases and parasites. When animals are subjected to these other factors, the effects of aflatoxins on animal performance may be greatly magnified. Also, since aflatoxins reduce the effectiveness of the immune system, animals may become more susceptible to infections while being fed aflatoxin contaminated feeds. Heat or cold stress and nutritional deficiencies may intensify the effects of aflatoxin levels which would otherwise cause no obvious reduction in performance. Therefore, the basic recommendations discussed here apply to healthy animals that are provided adequate nutrients, properly treated for parasites and housed in appropriate environments.

Determining Possible Use:

The aflatoxin level of the total ration determines the acceptability of that ration for feeding livestock. The amount of aflatoxin which a particular animal may tolerate is determined by the ability of the liver (and possibly other organs) to detoxify those aflatoxins. This level probably relates best to the amount consumed per day per pound of body weight. However, on a practical basis, the producer needs to know what level or concentration of toxin can be included in the ration without significant harm to the animal. Because the level of dairy feed intake of the animals is often difficult to determine, it is difficult to predict the expected results of feeding a particular batch of a feedstuff.

The feedstuff containing the aflatoxin should be properly analyzed for aflatoxins before the total ration is mixed. This will provide information to formulate the ration so that aflatoxin levels in the final ration may fall within the acceptable range for the particular class of livestock. It is also a

good idea to reanalyze the final ration to verify that the intended maximum level of alflatoxin was not exceeded. The following table gives the classes of livestock which may tolerate the given levels of aflatoxin in a total mixed ration.

POSSIBLE USE OF AFLATOXIN CONTAMINATED RATIONS

Aflatoxin levels, total ration - ppb[1]	Classes of livestock which may tolerate given levels[2]
38371	all classes
20-100	2, 3, 4, 5, 6, 7, 8, 9
100-200	3, 4, 7, 8, 9
200-400	7, 8, 9
400-500	8, 9
500 or above	none

[1] Parts per billion as-fed (Note beef cattle recommendations given on dry basis)
[2] Classes of Livestock:

1. Young pigs up to 50# body weight or 10-12 weeks of age (in creep or prestarter rations)
2. Sows nursing pigs.
3. Growing-finishing hogs - 50# to market.
4. Dry sows and boars in breeding herd.
5. Young calves (in creep rations).
6. Cows nursing calves.
7. Dry cows and bulls in breeding herd.
8. Feedlot or stocker cattle.
9. Mature horses.

Formulation:

The formulation of a ration containing one or more contaminated feedstuffs can be accomplished in several ways. One way is to divide the maximum tolerable aflatoxin level (see table) by the concentration of toxin indicated in the lab report. This will give the maximum level of that feedstuff allowed in the ration. Formulation can then proceed as usual. If it is desired to use higher levels of the ingredient than calculated as tolerable, a clean (uncontaminated) source of the ingredient should be secured for blending.

Example: Corn with 350 ppb aflatoxin is desired to be used in a growing-finishing ration for swine. Since the maximum tolerable level indicated for these animals is 200 ppb, we divide 200 by 350 to give a maximum use of the contaminated corn at 57 percent of the total ration.

$$\frac{200 \text{ ppb}}{350 \text{ ppb}} = .57 \times 100 = 57\%$$

Following formulation it is found that 80% corn is desired. Therefore 23% (80 - 57%) of the total ration must be uncontaminated corn from another source.

Another method of formulation is to use a computer formulation program such as The University of Georgia Extension Service's Feeder Series. Aflatoxin can be treated as a nutrient with a maximum restriction placed on the amount of this "nutrient". To achieve a feasible solution or successful ration, adequate sources of uncontaminated feedstuffs must also be offered for the computer's calculations. This method is advised when several rations are to be formulated from the contaminated feedstuff or when more than one contaminated source is to be used.

Blending of feedstuffs:

One approach to use aflatoxin contaminated feedstuffs has been to blend these materials with clean feedstuffs. The obvious intent of blending is to dilute the toxin to tolerable levels. Care must be taken to insure that active mold growth and possible toxin production has ceased. Otherwise, you may simply be inoculating the clean material with growing mold and further damaging the entire batch. Blending should be considered only after careful sampling and analysis and only if excellent mechanical means are available to thoroughly mix the feedstuffs. Use of a mold inhibitor in the blend and in any ration mixed from the blend is advisable. The federal policy on this practice has fluctuated over time and should be checked on before any blending is done on feedstuffs that could end up in interstate commerce.

Other treatments of feedstuffs:

The two most common methods proposed for treatment of aflatoxin contaminated feedstuffs are ammoniation and heat treatment. Procedures for ammoniation are detailed in the Extension publication "Treating Aflatoxin Contaminated Corn with Ammonia" (Bulletin 869) A complete cost analysis of this procedure should precede its implementation. Palatability of ammoniated feedstuffs has been a problem in some instances.

Roasting or heat treatment of aflatoxin contaminated feedstuffs has some potential. Reductions in analyzed levels of aflatoxins of 40 to 70% have been achieved in corn roasted to 290 to 320 degrees F. However, some destruction of amino acids is inevitable in the dark-colored, roasted corn. Typical grain dryers are not normally designed to achieve these temperatures but commercial grain roasters are available.

At the time, no other methods of destroying the toxins appear to be economical or practical.

Minimizing the effects of aflatoxins:

Another approach to use of contaminated feedstuffs has been to prevent detrimental effects in the animal or improve the animal's tolerance of aflatoxins in the ration. The most successful methods are added aluminosilicates and increasing protein (amino acid) levels. The use of hydrated aluminosilicates (HSCAS) in swine and cattle diets appears to reduce the absorption of aflatoxins thereby reducing their effects on the animal. There are currently no label claims approved by FDA for HSCAS related to counteracting aflatoxins; however, HSCAS is approved as an anti-caking agent in livestock feeds up to 2% of the ration. Levels as low as 10 pounds per ton (.5%) have been effective in reducing the effects of aflatoxin (460 ppb) in swine diets.

In poultry and swine rations, increasing the level of protein in the diet may help overcome the effects of aflatoxin on growth performance. There are indications that higher methionine levels may encourage the destruction of aflatoxin in the pigs body. Also the effects of reduced feed intake in the pig may be overcome, in part, by increasing the concentration of amino acids (especially lysine) and energy sources.

This overview of the use of aflatoxin contaminated feedstuffs should point out the major points which a farmer should consider. However, it is recommended that a county agent, Extension Animal Scientist or veterinarian be contacted before you proceed with plans to feed contaminated materials.

Rick Jones, Extension Animal Scientist

FORAGE TESTING

Forage testing is a greatly under utilized management tool in beef cattle production. Knowing the nutrient content of a particular forage allows producers to decide which of two hays to purchase, evaluate forage value on a nutrient basis and supplement the forage as needed, based on its nutrient content and the animal's requirement.

How to Sample

The most important part of a forage test is the sample itself. You will get an accurate estimate of nutrient content only if the sample is representative. To be representative several samples from each lot of forage should be pooled. A separate lot should be defined as being from each cutting from each field. This is necessary because each cutting (or lot) will have a different nutritive value.

* Sample hay preferable with a Penn State hay sampler. Your county agent should have one available.

* Sample square bales from the end of the bales. Sample at random approximately 10 bales from each lot of hay and pool them together. If the sample is too large, then mix thoroughly before filling the sample bag.

* Sample round bales from the side (with a string) when using the Penn State sampler. Grab from several sites on the flat side (reaching in as far as you can) when taking samples by hand. Take samples from 5-10 bales from each lot of hay.

* Sample stacks of hay at an angle (upward and downward) for best results. Sample from 3 sites along the side of the stack. Pool samples from 5-10 stacks in each lot of hay.

Where to Send

Currently, there are three laboratories in Georgia which test forages.

1. Soil, Plant and Water Lab
   2400 College Station Road
   Athens, Georgia 30602
   Cost: $8-$30 depending on analysis needed. See your local Extension Agent for details.

2. State Chemist
   Georgia Department of Agriculture
   State Agriculture Building
   Feed Lab
   Atlanta, Georgia 30334
   Cost: Free (includes moisture, protein fiber)

3. Tifton Seed Lab
   Cost: Free (includes moisture, protein,

Highway 41 South
Farmers Market
Tifton, Georgia 31793

Fiber)

Effect of Quality on Supplementation

When designing a winter feeding program, you should first consider the quality of forage available. The amount of protein and energy in forage determines the kind and amount of supplemental feed needed. Cattlemen are encouraged to produce the highest quality forage possible. However, almost any forage can be properly supplemented if its quality is known.

Table 3 gives examples of supplemental feeds for different quality hays. The quality of hay is determined by the concentration of crude protein (CP) and Total Digestible Nutrients (TDN). For example, hay that contains 8.5 percent crude protein and 51 percent TDN is estimated to be fairy quality. It would require a completely different supplemental feed than a poor quality hay.

The supplements suggested in the table are needed to provide enough protein and energy to properly balance that hay for a 1000 pound lactating brood cow. They hay is assumed to be fed free-choice. Each ration provides approximately 2.5 lbs. Of total protein and 11.5 to 12 lbs. TDN. As the quality of hay declines, the amount of needed supplement increases.

Some feeds are suitable to supplement good quality hay, but are inadequate for poor quality hay. Examples are protein blocks and liquid protein. As long as the hay is of good quality, protein energy. However, because they contain ingredients which limit the amount a cow will eat, these type supplements are not adequate for lower quality hay.

The supplements in the table are examples. There are many other feeds which can be used equally as well. A good example is winter annual grazing. Two to four hours a day of winter annual grazing will substitute for any of the supplements listed.

A good way to compare hays of different quality is the cost of supplementation. Poor to fair hay cost $.22 more per day (based on corn and BM) than Good + hay; it costs $.38 more to supplement than Excellent quality hay. For 100 cows and 120 days of winter feeding, this amounts to $4,500 difference in the feeding program.

In addition to supplemental protein and energy, beef cows will need a source of vitamin A, calcium and phosphorus. A convenient method to provide these nutrients is to offer a free choice salt/mineral mix containing 9-12%, calcium, 6-9% phosphorus and 140,000 units vitamin A per pound of mineral.

TABLE 3. SUPPLEMENTS FOR HAY

Supplement Cost Per

Quality of Hay	Chemical Analysis CP TDN		Supplemental Programs	Cow Per Day ($)
Excellent	11.2 & over	56 & over	None (unless cows are in poor body condition at calving)	0
Good +	9.5 - 11.1	53 - 56	1) lb. SBM & l lb corn	.16
			2) Protein Blocks	.22
			3) Liquid Protein	.18
			4) 2.5 lb Range Cubes (low fiber)	.30
			5) 2.5 lb Whole Cottonseed	.11
Fair to Good	8.2 - 9.5	50-53	1) 2 lb. SBM + 1.5 lbs. Corn	.30
			2) Protein Blocks (designed for 3-4 lbs Dairy Consumption	.53
			3) 4.5 lbs. Range Cubes (low fiber)	.54
			4) 4.5 lbs. Whole Cottonseed	.19
Poor to Fair	7.3 - 8.2	50 & under	1) 2.5 lbs. SBM + 2.0 lbs. Corn	.38
			2) 6.5 lbs. Range Cubes	.78
			3) 6 lbs Whole Cottonseed	.26
Very Poor	under 7.3	49 & under	1) 3.0 lbs. SBM + 3.0 lbs Corn	.49
			2) 7.5 lbs. Range Cubes (low fiber)	.90
			3) 7 lbs Whole Cottonseed	.30

Based on: Corn = $3.00/bu; SBM = $220/ton; Protein Blocks = $15/cwt; Liquid Protein = $175/ton; Range Cubes = $240/ton; Whole Cottonseed = $85/ton

After reviewing the table, it should be obvious that the variation in hay quality makes a large difference in the overall feeding program. Without knowing the quality of your hay, you could easily be overfeeding or underfeeding your cows. Both will result in expensive mistakes. In order to supplement your hay properly, have it tested for quality.