Beef Management Practices When Forages are in Short Supply

Ron Lemenager, Purdue Animal Sciences
Keith Johnson, Purdue Agronomy

When environmental conditions are less than ideal, forage production will be reduced. The most common cause of low forage yield is less than average rainfall in the late spring and summer which is often accompanied by high environmental temperatures. Harsh winter conditions or early spring freezes can also result in less than optimum forage supplies.

Unfortunately, there are no cheap, easy fixes for beef producers who have both short pastures and limited hay supplies. Good management means beef producers should develop and implement a strategy that specifies what to do with pastured animals and where winter feed supplies will come from long before the last blade of grass or bale of hay disappears. If not properly managed, a drought year can affect the bottom line for three years: in the first year, feed costs increase and calf weaning weights are decreased; in the second year calf vigor, colostrum quality, milk production, calf weaning weight, cow reproductive performance, and forage production all suffer; and in the third year the calf crop weaned and forage production are still impacted. Proper planning and management can minimize the longer term economic impact.

This publication reviews 16 management practices that can be used in various combinations to help reduce the negative consequences of low forage supplies. When forage supplies are low, producers should consider the following:

1. Monitor the body condition of cows as a barometer of nutritional status.
2. Avoid overgrazing and employ rotational grazing.
3. Creep feed calves to create near normal weaning weights.
4. Early wean calves to take pressure off both cows and pastures.
5. Identify and manage poisonous plants in pastures and hay fields.
6. Establish summer annuals to increase late season forage production.
7. Pregnancy check and market cull cows earlier than normal to reduce feed needs.
8. Inventory hay and other feed resources.
9. Analyze feeds for nutrient profiles to help determine supplemental feed needs.
10. Use alternative feeds to supplement and stretch forage supplies.
11. Limit hay access time to stretch forage supplies.
12. Limit feed a nutrient dense diet to stretch forage supplies.
13. Use drought-stressed corn for silage, green chop, hay, or grazing.
14. Graze crop residues and stockpiled forages to reduce harvested feed needs.
15. Provide clean, cool water to reduce heat stress and maintain herd health.
16. Add moisture around electric fence ground rods.

1. Monitor Body Condition of Cows As a Barometer of Nutritional Status.

Use body condition scores (BCS) as a composite management tool to determine if the cow's environment is in balance. BCS is an easy, economical way to evaluate the body energy reserves of the cow herd, and it is a better indicator of nutritional status and reproductive performance than weight. Cows should be maintained near a body condition score of 5 (1-9 scale). A "how to" video is available at the Purdue beef website (www.thebeefcenter.com).

Condition scoring allows a producer to manage feed resources by sorting cows into groups and then feeding them according to their nutritional needs. In order of importance, beef cattle use nutrients for: body maintenance, fetal development, lactation, growth, and conception. As an animal satisfies each requirement, any excess nutrients are available to the next priority. When nutrients are limited, reproductive performance is the first to be compromised followed by animal growth and milk production (calf weaning weight), respectively.

2. Avoid Overgrazing and Employ Rotational Grazing.

Forage plants need a rest period between grazing cycles to replenish carbohydrate reserves in their storage organs. Without rest, plants will weaken and take longer to recover. Pastures that are continuously over-grazed, typically lose many desirable high-yielding forage species. During a drought, this result will be magnified and it is very likely to take several years for the pastures to return to normal even when properly managed.

The old grazier's recommendation to "graze half and leave half" is still good advice. The problem during droughty periods is that regrowth is limited in pastures, even when they have been rested for 30 to 45 days between grazing cycles. Ideally, cattle should be removed from pastures when plants are grazed to about a 4-inch stubble height. This will allow enough leaf material for photosynthesis to occur and carbohydrate reserves in the plant storage organs to allow more rapid regrowth when environmental conditions improve.

If all pastures have been grazed to a 4-inch stubble height and no regrowth has occurred, it is recommended to drylot cows, or designate a sacrifice area within a pasture with temporary fence, and provide alternative feeds. Resumption of grazing in any given pasture should be delayed until plant regrowth reaches 8 to 10 inches in height to minimize long-term damage. Pastures that are managed properly will need significantly less time to recover when environmental conditions improve.

3. Creep-Feed Calves to Create Near Normal Weaning Weights.

It is important to understand the objective of creep feeding. When nursing calves are provided supplemental feed, it takes some pressure off the cows and can boost calf weaning weights, but it does little to stretch forage supplies. If the objective is to stretch forage supplies, early weaning of calves is a better option. If the goal is to improve calf weaning weights without drylotting calves, creep feeding may be the more desirable option. Purdue data suggests that creep feeding calves for approximately the last 3 months prior to weaning (120 to 205 days of age) can increase calf weights by an average of 30 to 50 pounds (variation of 0-125 pounds) and cow weights by 30 to 50 pounds (variation of 0-200 pounds) by normal calf weaning time.

The response to creep feeding depends on forage quality, forage availability, and location of the creep feeder. In years when forage quality and/or quantity is limited, the response to creep feeding (calf gain and feed efficiency) is higher than when forage quality and quantity are both high. Creep feed conversion to additional calf gain ranges from a low of 5:1 to as high as 15:1. If creep feed cost is $300 per ton (0.15¢/lb) with a feed:gain conversion of 5, 10 and 15:1, then the cost of additional calf gain, respectively, is $0.75, $1.50 and $2.25 per pound. Creep feeders should be placed where cows congregate such as near water, mineral feeder, and shade to maximize a calf gain response.

Implanting calves has the potential to increase calf average daily gains by up to 10%. Therefore, if calves are gaining 2.5 pounds per day as a result of creep feeding, a 25 pound increase in weaning weight and a 10:1 return on investment could be expected. It is recommended that all steers and non-replacement quality heifers be implanted. Implanting is not recommended, however, for heifers and bulls that are retained for breeding since future reproductive performance can be compromised.

Table 1 provides sample creep rations that should support gains of approximately 2.5 pounds/day. Calves should be vaccinated for over-eating disease (clostridia type C&D antitoxin) preferably a minimum of 2 weeks prior to creep-feed initiation. Once creep feeding starts, care should be taken to not let the creep feeder run empty. If feeders run empty, and when feed is reintroduced, calves are at risk of over-eating which can cause digestive upsets such as bloat or acidosis. Purdue research with creep diets recently compared creep diets that contained a mixture of soybean hull pellets and corn gluten pellets. The ratios compared were 60:40 and 40:60. Calf gain, feed required per pound of additional gain, cow performance (weight and body condition change) were very similar between treatments. Ration 3 in Table 1 reflects a 50:50 ratio of these two pelleted feeds.

Table 1. Sample creep rations (%, as-fed basis) [1].

Ingredient	Ration 1	Ration 2	Ration 3	Ration 5
Corn, cracked	40.0	32.7	—	32.75
Oats, crimped	40.0	32.7	—	—
Soybean meal, 48%	18.0	—	—	—
Soybean hulls, pelleted	—	—	49.2	32.75
Dry corn gluten feed, pelleted	—	—	49.2	32.75
Dry distiller's grains + solubles	—	32.7	—	—
Limestone, feed grade	2.0	1.9	1.6	1.75

[1]To be fed to nursing calves with free-choice forage and high-quality cow mineral, fortified with vitamins A and E, magnesium, copper, zinc and selenium.

4. Early Wean Calves to Take Pressure Off Both Cows and Pastures.

Early weaning of calves is a viable option for conserving short forage supplies. Early weaning not only lowers forage intake of cows, but also improves cow body condition by removing the nutrient requirements associated with lactation. In addition, early weaning eliminates pasture forage consumption and trampling losses associated with the calves. Based on Purdue data, early weaned, early-gestation cows will consume approximately 25 percent less dry matter than cows nursing calves. When all factors are considered collectively, it is possible to conserve more than 30 percent of a pasture resource by early weaning calves.

When forage resources are limiting, non-lactating cows in the first trimester to mid-second trimester of pregnancy (a period of low nutrient requirements) can maintain or gain body weight and condition much more easily than late gestation or early lactation cows. In a normal year, it is not uncommon for spring calving cows with early weaned calves to enter the winter with a 0.5 to 1.0 body condition advantage (40 to 80 pounds) over cows that have normal weaned calves. More body condition (and weight) difference would be expected in a hot, dry year. In addition, early weaned calves are much more efficient in converting feed to gain (~4:1) than feeding cows to support lactation and calf gain.

Based on Purdue research, it is recommended that individual calves need to be at least 70 days old when weaned. Calves weaned at younger ages tend to have stunted growth and have the appearance of pot-bellied, orphaned calves. Ideally, calves should be vaccinated for IBR, PI_3, BVD, BRSV, and clostridia prior to weaning, and then receive booster vaccinations before or at weaning, and again when calves are about 7 months of age to prevent sickness. It should be noted that creep feeding calves for a short period of time (14 to 28 days) prior to early weaning can ease the weaning transition by acclimating calves to eating a dry, nutrient dense feed from a feeder.

Table 2 provides sample early wean rations that should support gains of about 2.4 lb/day when fed to a 350 pound calf at 2% of its body weight per day (350 x .02 = 7 lb/day) and allowed free-choice access to good quality grass or grass-legume hay, a good commercial vitamin-mineral mix, and fresh water. Adding an ionophore (Rumensin® or Bovatec®) to the early wean ration will help stabilize intake, minimize coccidiosis, and improve feed efficiency.

If calves were not creep-fed before weaning, begin feeding the grain mix at 0.5 percent of body weight per day (for example, 350-lb calf x 0.005 = 1.75 lb/head daily). Increase grain mix gradually over the next 10 to 14 days to equal approximately 2.0 percent of body weight (for example, 350-lb calf x 0.02 = 7.0 lb/head daily). A rule of thumb for increasing the grain mix on early weaned calves is to add approximately 0.5 lb/head every other day. If calves were creep-fed prior to weaning, begin feeding grain mix at 1 percent of body weight. Ideally, the early wean ration would be the same, or very close to the same, as the creep ration, which can then be gradually transitioned to a new ration. When hand feeding an early wean ration, a good rule of thumb after transitioning calves, is to not exceed 2.0% of body weight of supplemental feed mix per day (i.e. 350 pound calf = maximum of 7 pounds/day). As calves increase in weight, adjust amount of feed mix delivered to approximate 2% of body weight.

Table 2. Sample early wean rations (%, as-fed basis)[1].

Ingredient	**Ration 1**	**Ration 2**	**Ration 3**
Corn, cracked	37.0	—	32.8
Oats, crimped	37.0	—	—
Soybean meal, 48%	24.6	—	—
Dry corn gluten feed, pelleted	—	59.0	—
Soybean hulls, pelleted	—	39.3	32.8
Dry distiller's grains + solubles	—	—	32.8
Limestone, feed grade	1.4	1.7	1.6
Vitamin-Mineral mix[2]	Free-choice	Free-choice	Free-choice
High quality grass or grass/legume hay	Free-choice	Free-choice	Free-choice

[1]Adding an ionophore, such as Rumensin® or Bovatec®, to the early wean ration will improve feed efficiency and reduce the chance of coccidiosis. These products are often packaged in a concentrate form. For example, Rumensin 80 refers to a feed additive concentration of 80 grams per pound. Adding 0.5 pounds of Rumensin 80 premix per ton of early wean ration will provide 20 mg of Rumensin per pound of ration (i.e. 6 pound of ration intake = 120 mg of Rumensin per day).

[2]High-quality mineral fortified with vitamins A and E, magnesium, copper, zinc and selenium.

5. Identify and Manage Poisonous Plants in Pastures and Hay Fields.

Animals typically avoid consuming poisonous plants when forage quantity and quality are adequate. However, poisonous plants can become a concern if they are included in harvested forage, or when pastures are overgrazed. Avoid overgrazing pastures that contain poisonous plants. For more information about managing poisonous forage plants, see *Guide to Toxic Plants in Forages* (Purdue Extension publication WS-37) and *Indiana Plants Poisonous to Livestock and Pets* (WS-9), available from the Purdue Extension Education Store, www.the-education-store.com.

6. Establish Summer Annuals to Increase Late Season Forage Production.

Annual warm-season grasses (such as sudangrass, sorghum-sudangrass, and pearl millet) are popular choices for picking up the summer slump and adding late season grazing, but these species require soil moisture to germinate and grow. Other warm-season grasses to consider include foxtail millet and teff grass.

If seeding annuals is part of a strategy to stretch available forage, seed should be purchased early since supplies can be quickly exhausted. If these forage grasses are not sown before late July, it is unlikely that the resulting value of the growth will exceed the costs of production. Another option would be to seed spring oat in mid-August. If the forage is to be grazed, adding forage turnip with the oat could be an alternative. Purdue Extension publication ID-317, *Forage Field Guide*, will provide suggested seeding date, seeding rate and best use practices.

Wheat acreage harvested for grain provides an opportunity for establishing these crops. Pearl millet typically yields somewhat less tonnage than sudangrass or sorghum-sudangrass. However, if there is an extreme drought or killing freeze, pearl millet does not carry the same risk of prussic acid poisoning that sudangrass or sorghum-sudangrass pose.

It is critical to review labels of herbicides recently used to make sure that the time interval between herbicide applications and seeding of the desired crop has been met. If it has not, the desired crop may die because of residual herbicide remaining in the soil. Herbicide residues are likely to be greater in a drought year.

7. Pregnancy Check and Market Cull Cows Earlier Than Normal to Reduce Feed Needs.

In most years, feeding non-productive and less productive cows will increase costs and decrease profitability. Most large-animal veterinarians, or the newer commercially available blood tests, can accurately determine pregnancy in cows that are 35 days pregnant. If the calving/breeding season was longer and later than desired, one might consider selling the late-calving cows (regardless of pregnancy status, with or without calf at side) and pregnancy checking only those cows that calved early.

Consider culling all open cows and those that have bad attitudes; lost their calves; failed to conceive; soundness issues caused by age, arthritis, disease, or injury; and those that have a history of weaning lightweight calves. Historically, cull cow prices dip in the fall (October and November) when the cow market is flooded by many herds following weaning of their late winter and spring-born calves. During a widespread forage shortage, cow prices often become depressed earlier. Therefore, identifying and selling cull cows earlier, rather than later, can also return more dollars and reduce feed costs. When cow prices are depressed, producers must decide if it is more profitable to sell cows or buy feed in anticipation that good prices will return later. For producers that have feed; buying good, young, pregnant cows that are culled from well managed herds, when prices are depressed, may increase profits in the longer term.

8. Inventory Hay and Other Feed Resources.

For planning purposes, one can assume that a cow will consume about 2.5 percent of her body weight of average-quality hay per day on a dry matter (DM) basis. Hay stored outside will have about a 20 percent waste factor; hay stored inside will have about a 7 percent waste factor. For example, the estimated forage needs for a herd of 30 cows with an average cow weight of 1,250-pounds consuming average-quality hay stored outside for a 150 day feeding period would be calculated as follows:

(1250 lb cow x .025 x waste factor of 1.2) = 37.5 lb of hay DM disappearance per day

If the hay feeding period is from December 1 to May 1 (150 days), then each cow will need:

(37.5 lb of hay DM per day x 150 days) = 5,625 lb of hay DM/cow for the feeding period

Bales stored inside will typically contain 88 percent DM, while bales stored outside will typically contain about 80 percent DM. If bales stored outside weigh 1,200 pounds, then the bale DM weight in this example would be:

(1,200 lb per bale x .80) = 960 lb of hay DM per bale

Each cow in this example would need:

(5,625 lb of hay DM ÷ 960 lb of hay DM per bale) = 5.9 bales for the feeding period

If there are 30 cows, then:

(5.9 bales per cow x 30 cows) = 177 bales would be the estimate of hay needed for the winter feeding period

9. Analyze Feeds for Nutrient Profiles to Help Determine Supplemental Feed Needs.

Obtain representative forage samples from each field and harvest date, and then have a certified forage testing laboratory analyze them for their nutrient profile. Testing laboratories can be found on the National Forage Testing Association website (www.foragetesting.org). A basic nutrient analysis should contain the amount of dry matter (DM), energy (TDN or NE), crude protein (adjusted for heat damage), neutral detergent fiber (NDF), calcium, phosphorus, potassium, and magnesium. In the case of drought stressed corn, sorghum or millet, a nitrate analysis would also be justified. From this nutrient profile, a safe diet can be formulated to meet the animal's requirements in a cost-effective manner to optimize performance.

10. Utilize Alternative Feeds to Supplement and Stretch Forage Supplies.

In severe situations, counties may receive a release of Conservation Reserve Program (CRP) acres for grazing and possibly hay harvest. Typically, the quality of forage from these acres is very low, but it is a resource that can be considered. If CRP acres are a consideration, make sure to check with the local Farm Service Agency (FSA) office for requirements and restrictions.

When forage supplies are short, crop residues such as wheat straw and corn stover should also be considered. Crop residues are not a direct substitute for high-quality pasture or hay, but when properly supplemented, these resources can satisfy cow requirements during both gestation and lactation.

There are two crop residue feeding strategies to be considered. The first feeding strategy is to use crop residues as a roughage resource that can be supplemented with byproducts. Since crop residues and other low-quality, mature forages are characteristically low in both protein (typically 4 to 5 percent crude protein (CP)) and energy (45 to 50 percent total digestible nutrients (TDN)), corn byproducts (such as corn gluten feed and distiller's grains) become attractive sources of these two nutrients.

For comparison, the CP requirement of beef cows is about 8 percent during mid-gestation and 12 percent during early lactation; the TDN requirement is about 53 percent during mid-gestation and 63 percent during early lactation. On a dry matter basis, corn gluten feed contains about 22 percent CP and 80 percent TDN, while distiller's grains plus solubles contain about 30 percent CP and 90 percent TDN.

Corn byproducts need to be fed to cows with caution. Overfeeding these byproducts can result in excessive amounts of dietary fat (which can affect rumen fermentation), sulfur (which can bind with copper and reduce reproductive performance), and nitrogen (which has the potential to increase calf birth weights when cows are fed during late gestation and lower fertility/reduced embryo survival when fed during early lactation). Table 3 provides sample rations that are safe for a 1250 pound non-lactating cow in mid-gestation working in an 85° F environment and gaining weight.

Table 3. Sample non-lactating, mid-gestation cow rations (lb/day as-fed basis)[1].

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4
Wheat straw	Free-choice	Free-choice	—	—
Corn stover	—	—	Free-choice	Free-choice
Dry corn gluten feed, pelleted	6.0	—	5.0	—
Dry distiller's grains + solubles	—	5.0	—	4.0
Limestone, feed grade	0.20	0.20	0.10	.10
Vitamin-Mineral mix[2]	Free-choice	Free-choice	Free-choice	Free-choice

[1]Assumes a 1,250-pound non-lactating cow, 2-6 months pregnant in an 85° F environment and gaining about 0.4 lb/day.
[2]High-quality mineral fortified with vitamins A and E, magnesium, copper, zinc, manganese and selenium.

A second feeding strategy is to treat crop residues and CRP hay with anhydrous ammonia to increase their forage intake and protein content, as well as improve forage digestibility and cow weight/BCS change. This strategy is less attractive than the first because of the cost of anhydrous ammonia and the safety risks associated with its application. In a drought year, anhydrous ammonia treatment of wheat straw and CRP hay is much more attractive than treating corn stover, and especially if the stover is high in nitrate concentrations. Purdue research has shown that adding anhydrous ammonia to large round bales of crop residues at the rate of 3 percent of the forage dry matter will increase the crude protein content (6 to 8 percentage points) and dry matter digestibility (more than 4 percentage points in corn stover and more than 10 percentage points in wheat straw). In essence, these crop residues become similar to moderate quality hay when properly treated with anhydrous ammonia. In the Purdue studies, supplements were formulated to meet cow requirements for protein, vitamins, and minerals for 90-day feeding trials during late gestation. Cows that received the anhydrous ammonia-treated residues (plus a corn supplement) consumed 23 to 30 percent more dry matter and were more than 60 pounds heavier than cows fed non-treated residues (plus soybean meal supplement). The condition score changes followed the same pattern as weight change. Resources are available on the Purdue beef website (www.thebeefcenter.com) on how to treat low quality forages with anhydrous ammonia.

Soybean was first introduced into the U.S. as a forage hay crop and it can be used in beef rations. Soybean, however, has tremendous capacity to flower over an extended period of time which allows them to still make a grain crop worthy of harvest during moderate drought conditions. If soybean fields are abandoned as a grain crop in times of a severe, prolonged drought, they can have a nutrient profile comparable to good alfalfa hay down to twigs on a tree. Variation in nutrient profile is largely determined by stage of plant maturity and the amount of leaf material that can be harvested. Making good quality hay can be difficult because the stems and pods cure slowly and leaf loss can become an issue. Crimping the hay will help speed drying. Making haylage or baleage is an attractive alternative that will minimize the challenges of both dry down and leaf loss. A forage analysis will provide valuable information when formulating diets. There are two important considerations before harvesting soybean as a forage crop. a) Check with the crop insurance agent to completely understand the rules and requirements of the policy so that coverage is not jeopardized. b) Read the label on all pesticides used since there are many label restrictions that prevent soybean use as a forage resource. Soybean straw following the combine is extremely low quality and is not recommended as a primary feed. It may have some value as a roughage factor when limit feeding a nutrient dense diet, or when it is used as low nitrate diluter feed when fed in combination with a high nitrate feed. Free-choice intake of soybean straw will be low. When used to dilute nitrates, it is best blended into a total mixed ration (TMR).

11. Limit Hay Access Time to Stretch Forage Supplies.

Results from several Purdue studies with dry, gestating beef cows suggest that beef producers can stretch their supplies of moderate-quality orchardgrass-alfalfa hay by limiting cow access time to large round bales. In 90-day studies, late-gestation cows were allowed 4-, 8-, 12-, and 24-hour per day access to large round bales fed in a hay feeder. Feeder space was adequate to allow all cows in each treatment simultaneous access to hay. Cow weight change and body condition score change were not significantly affected by length of access time and all cows gained weight.

Limiting access time to large round bales significantly reduced the amount of hay disappearance. Total hay dry matter disappearance was reduced by 37.2 percent when cows had access to hay for only four hours per day compared to cows that had 24-hour per day access. Limiting cow access time to eight hours per day reduced hay disappearance by 17.6 percent, while limiting access time to 12 hours/day reduced hay disappearance by 4.4 percent. A significant amount of this reduction in hay disappearance was due to sorting and wastage of hay outside the bale feeder. From these studies, it was concluded that cows will eat all the dry matter they can consume for the day in 6 to 8 hours of access time to large round bales while minimizing waste.

In a second set of Purdue studies, access time was limited to 1, 2 and 4 hours per 24-hour period of a low quality grass hay, a mixed grass-legume hay, and a high quality grass hay. The amount of hay intake varied slightly (Figure 1), but averaged about 0.6%, 1.0% and 1.7% of the cow's body weight on a dry matter basis, respectively. This resulted in hay savings of about 70%, 50% and 20%, respectively, compared to 24-hour per day access. Figures 2, 3 and 4 show the hay intake of low quality grass, mixed, and high quality grass hays and the amount of soybean hulls needed for each access time to meet the energy and protein requirements of a 1250 pound cow in late gestation gaining .25 pound per day. When hay intake can be accurately estimated, then a nutrient dense supplementation strategy can be developed. Forage dry matter intake (DMI) for cows with limited access times of 1 to 4 hours per day can be estimated using an equation developed from this Purdue research. The equation is:

Hay DMI (expressed as a percent of cow body weight) = 0.30 x Hours access time per day – (.02 x Hay NDF%) + 1.34

Where: body weight is for a moderate body conditioned cow at weaning time, and NDF is the percent neutral detergent fiber value from a forage analysis on a DM basis.

When cows are limit-fed, it is important to realize that free-choice consumption of a vitamin-mineral mix can exceed the desired level of 3 to 4 ounces (about one fourth pound) per day and it may be necessary to add additional salt as an intake limiter to achieve the desired level of mineral intake. It is entirely likely that total mineral (salt plus vitamin-mineral mix) could approach a pound or more per day.

Limiting access time to corn hay that contains high nitrate concentrations is a strategy that can be used under very careful management. A good hay sample must be taken and a nitrate analysis will be needed. Armed with this information, a strategy can be developed that will not only adapt the rumen to tolerate higher nitrate levels, but also limit intake of the high nitrate feed. It will allow producers to extend their low nitrate forages, but not completely replace them. Diets can be formulated to also use byproducts that will help reduce nitrate intakes.

Figure 1. Hay consumption of different hay qualities by access time.

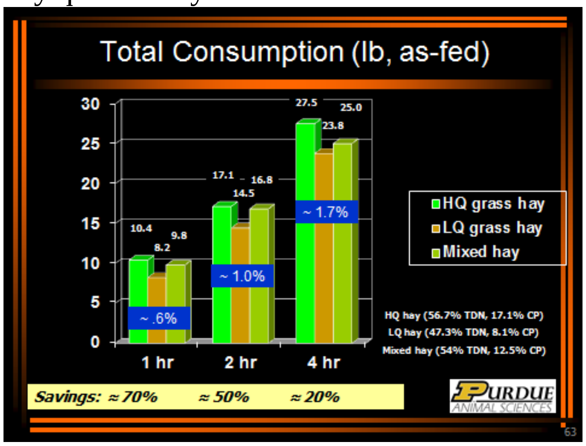


Figure 2. Low quality hay intake by access time and amount of soybean hull supplementation.

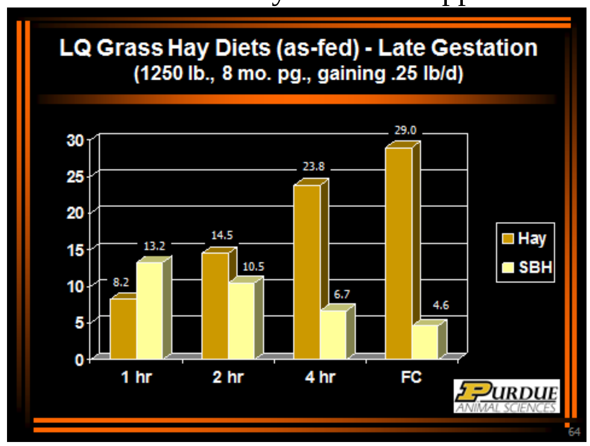


Figure 3. Mixed hay intake by access time and amount of soybean hull supplementation.

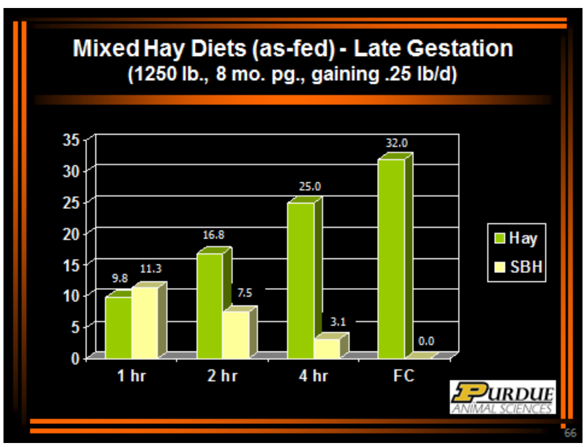
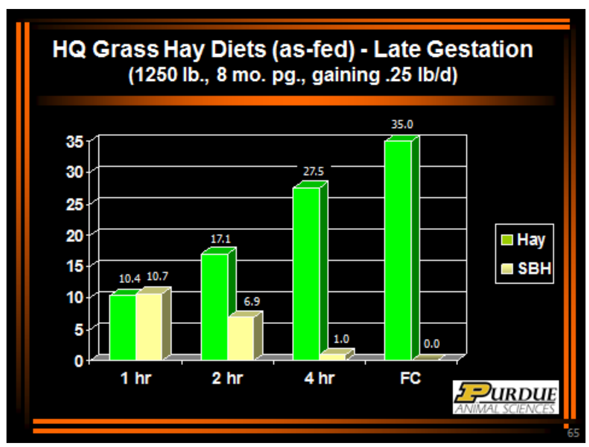


Figure 4. High quality hay intake and amount of soybean hull supplementation.



12. Limit Feeding a Nutrient Dense Diet to Stretch Forage Supplies.

Purdue research suggests that limiting daily hay intake (or access times to four hours or less per day) can meet cow requirements when fed a properly formulated, nutrient dense supplement. This strategy requires careful management and 30 inches of bunk space per cow to provide equal access to limited amounts of feed. Cows should be separated into at least two feeding groups: the first contains young, subordinate, and old cows; while the second contains mature cows. It is important to observe the dominant - subordinate relationships between cows when they are fed and it may be necessary to reassign some animals to another feeding group. Similar to starting feedlot cattle on feed, cows need to be started slowly on the supplement and the amount delivered per cow must be increased gradually over time. A good rule of thumb is to begin by feeding hay free-choice with supplemental feed at 4 pounds per cow. Increase the nutrient dense supplement amount by 1 lb/head on an every other day basis. When cows reach the desired level of supplement feeding, begin to gradually reduce the amount of hay fed to the designated level. When limit-feeding is initiated, cows will bawl and think they need to be fed more, but they will adapt to not having a full rumen in several days.

Sample rations for a 1,250-pound cow maintaining weight during mid-gestation and working in an 85^{o} F environment are shown in tables 4 (non-lactating) and 5 (lactating). Note that free-choice trace mineralized salt will not meet the cows' mineral or vitamin requirements. Magnesium, copper, zinc, manganese and Vitamin A are deficient in all of these limit-fed diets, therefore, a high-quality mineral mix that contains these minerals and Vitamin A needs to either be added to the concentrate mix, or provided free-choice. When corn-based byproducts are in the diet, it is important to supply a mineral mix that contains additional calcium (feed grade limestone or calcium carbonate) to balance the calcium:phosphorus ratio. In contrast, when corn-based byproducts are not included in the diet, more phosphorus (dicalcium phosphate) may be needed in the mineral mix.

Table 4. Sample limit-fed rations for a 1250 lb, dry, mid-gestation cow (lb/day, as-fed basis)[1].

Ingredient	Ration 1	Ration 2	Ration 3	Ration 4
Grass hay, moderate quality[2]	7.5	7.5	7.5	7.5
Corn, cracked	3.5	—		
Soybean meal, 48%	1.5	—	—	—
Soybean hulls, pelleted	—	5.0	—	—
Dry corn gluten feed, pelleted	—	—	5.5	—
Dry distiller's grains + solubles	—	—	—	5.0
Limestone, feed grade	0.10	—	0.20	0.30
Vitamin-Mineral mix[3]	Free-choice	Free-choice	Free-choice	Free-choice

[1]Assumes: (A) a 1,250-pound non-lactating, cow that is 4 months pregnant in an 85^{o} F environment and maintaining weight, and (B) cows are fed a moderate-quality grass hay stored inside with 88% dry matter.
[2]Cows can be limit fed this amount by limiting access time of large package bales to about 1 hour per day.
[3]High-quality mineral fortified with vitamins A and E, magnesium, copper, zinc, manganese and selenium. Salt may need to be added to lower the vitamin-mineral mix consumption to 0.25 lb/day (note- total consumption with the added salt could be 1 lb or more per day.

Table 5. Sample limit-fed ration for 1250 lb, lactating, mid-gestation cow (lb/day, as-fed basis)[1].

Ingredient	Ration 1	Ration 2	Ration 3
Grass hay, moderate quality	7.5	7.5	7.5
Soybean hulls, pelleted	10.0	5.25	—
Dry corn gluten feed, pelleted	—	5.25	—
Dry distiller's grains + solubles	—	—	9.5
Limestone, feed grade	—	0.20	0.50
Vitamin-Mineral mix[2]	Free-choice	Free-choice	Free-choice

[1]Assumes: (A) a 1,250-pound lactating cow that is 4 months pregnant in an 85^{o} F environment and maintaining weight and (B) cows are fed a moderate-quality grass hay stored inside with 88% dry matter.

[2]High-quality mineral fortified with vitamins A and E, magnesium, copper, zinc, manganese and selenium. Salt may need to be added to lower the vitamin-mineral mix consumption to 0.25 lb/day (note- total consumption with the added salt could be 1 lb or more per day.

13. Use Drought-stressed Corn for Silage, Green Chop, Hay or Grazing.

Before using drought stressed corn as a forage resource, several items need to be considered. a) If corn is covered as a grain crop by crop insurance, it is imperative that policy holders check with their insurance agent prior to harvesting plant material as a forage crop. There are a number of variations in how crop insurance coverage is defined and there needs to be complete understanding of the policy rules before harvest so that settlement is not jeopardized. In many cases there is a requirement to have an adjuster appraisal and/or leaving test strips to provide a yield estimate before a fair insurance settlement can be determined. b) Review pesticide (herbicide and insecticide) labels of products used in the corn field to minimize any potential residues. Pesticide residues would be expected to be more of a concern in a dry year compared to a normal year. c) All drought stressed forage from corn, sorghum and millet has the potential to contain high concentrations of nitrate which can be toxic, if not managed correctly. Risk of nitrate poisoning increases when unadapted, hungry animals are fed large amounts of corn, sorghum or millet forage. In addition, nitrate concerns increase when heavily fertilized, drought stressed fields are harvested shortly after a rain event. Herbicide applications that interfere with normal plant function, photosynthesis, or nutrient movement in the plant can also contribute to nitrate accumulation in some plants.

The first rule of managing feeds that have potentially high nitrate concentrations is to obtain a nitrate analysis from a certified laboratory (testing laboratories can be found on the National Forage Testing Association website (www.foragetesting.org). Knowing what these feeds contain is an important first step in creating a diet that is safe to feed. Second rule is to make sure cows are full before introducing a suspect feed. The risk of nitrate toxicity increases when unadapted, hungry animals consume large quantities of high nitrate feeds in a short period of time. Third rule is to start feeding suspect feeds in small amounts, maybe twice per day, and increase gradually over the next 7 to 10 days. This facilitates rumen microbe adaptation and allows the animal to more safely consume feeds with higher nitrate concentrations. Fourth rule is to dilute any feeds that might contain high nitrates. Providing a hay bale along with corn stalk bales; or feeding 2 to 3 pounds of corn, corn gluten feed pellets, or dry distiller’s grains per cow daily can serve as a diluter. Total mixed rations are safer than feeding feeds separately.

Drought-stressed corn, sudangrass, sorghum-sudangrass, millet, spring oat and weed (such as pigweed, common lambsquarters, and Johnsongrass) can contain high levels of nitrates. Nitrate levels in plants can go up and down rapidly, but nitrates tend to accumulate in the lower parts of the stalks, not in the seed or upper leaves. Cool-season grasses such as tall fescue, orchardgrass, and timothy typically do not accumulate significant amounts of nitrate, and legumes are seldom a problem.

The symptoms of acute nitrate poisoning are related to the lack of oxygen transport to tissues caused by a rapid conversion of hemoglobin to methemoglobin in the blood. Acute nitrate toxicity symptoms include depressed appetite, belligerent or disoriented behavior, uncoordinated hind quarter movement, inability to stand, frequent urination, increased heart rate, difficult or rapid breathing, silent heats, cyanosis, coma, and death. Less severely affected animals may be listless and only show rapid respiration when exercised. Chronic cases of nitrate toxicity may go undetected, but often result in reduced milk production, animal performance, feed conversion and reproductive efficiency. Nitrate related abortions have been reported during early gestation due to interference with fetal implantation within the uterus, and during late gestation resulting from a lack of oxygen and nutrient transfer across placental membranes. Symptoms of nitrate toxicity in calves are that they can be born 1 to 4 weeks early and often die within 24 hours. A postmortem examination of what appears to be a normal calf, sometimes reveals heart defects; hemorrhaging in the heart and trachea; general vascular, ruminal and abomasal congestion; dark red to coffee brown blood color within 1 to 2 hours after death; and nitrate presence in eye fluid.

In animals where nitrate toxicity is suspected, an examination of mucous membranes around the eyes, and between the lips of the vulva of cows, often reveals a color change from pink to blue-grey. This color change is an indication that oxygen transport to these tissues is being impaired. Veterinarians have various drugs and antidotes that can be administered to relieve acute nitrate poisoning symptoms, however, chronic symptoms are not cured by these administrations. The most common treatment of acute nitrate toxicity is the intravenous administration of methylene blue which is capable of converting methemoglobin back to hemoglobin.

Ensiling whole plant corn suspected of containing elevated nitrate concentrations is the safest way to feed it since the fermentation process has the potential to reduce nitrate levels by 40 to 60 percent. Extremely dry crops that are ensiled may lose only 20 percent of the nitrate they contain. In cases where fields have been declared a loss, and acres are not a limiting factor, the cutter bar should be raised to at least 12 inches above the ground to eliminate harvesting the lower stalk material which has the highest potential for nitrate accumulation. Corn harvested for silage should be in the 30 to 45% dry matter (55 to 70% moisture) range to ensure good fermentation and a resulting reduction in nitrate concentration. A quick way to determine if the plant contains too much moisture is to hand-squeeze a representative sample collected from the forage chopper and if water drips from the sample, it is too wet for ideal fermentation. Green, barren corn plants will typically be wetter than they appear in the field and can contain well over 70% moisture. An easy, accurate way to estimate moisture of the standing crop is to harvest about 20 stalks that fairly represents the field, chop them using a chipper/shredder used to process tree branches, mix the chopped material to get a representative sample, and then use a Koster Forage tester or microwave oven to dry the samples and a gram scale to weigh samples. Procedures to determine moisture (or dry matter content) can be found on the Purdue beef website (www.thebeefcenter.com). Wood chipper/shredders may be available between friends and neighbors or through the local parks and recreation or highway departments.

There are many types of storage structures available for silage (bunker silos, upright silos, silage bags, baleage (individual wrapped or in-line wrapped), and stacks (or piles) covered with plastic. For small scale operations, the best option for making silage is the use of silage bags or making baleage. In the case of silage bags, the logic is that there is approximately one ton of silage per foot in an 8 foot diameter bag. When small numbers of animals are fed, it will be easier to keep the silage face fresh and minimize air infiltration back into the bag that can result in heat and mold formation. Baleage is probably the second best alternative for smaller operations. Placing a stack or pile on the ground and covering it with plastic is the least desirable method of storage because it is harder and more dangerous to pack, there is the potential to have excessive losses due to spoilage (resulting from a larger surface area being exposed to the air), and there is an increased probability of leachate. If a stack/pile is to be used, leachate can create an environmental challenge. The Indiana Department of Environmental Management (IDEM) has levied fines to individuals when leachate has entered into streams and creeks. Leachate can be minimized by harvesting at the proper moisture levels (55 to 70%). If leachate is noticed surrounding a stack/pile, dry baled forage can be placed along the perimeter to serve as a temporary dike and to absorb excess runoff of moisture and nutrients from the leachate.

The feeding value of drought stressed corn silage, if made properly, can be 80 to 100% of normal corn silage for beef cattle. Work done at Purdue resulting from the drought in 1988 compared steers fed drought stressed silage (6 bushels/acre, 6 tons/acre) with corn silage from the previous year (175 bushels/acre). Both diets were supplemented to meet protein, vitamin and mineral requirements. Steers fed the drought stressed corn silage ate more dry matter and gained slightly faster than steers fed normal silage, but had a reduction in feed efficiency. We would expect drought stressed corn silage to have 1 to 2 percent more protein, slightly more fiber, and slightly less energy than normal corn silage. A good rule of thumb is that drought stressed corn with little or no grain, harvested at 70% moisture, will yield about 1 ton of silage per foot of plant height.

During the ensiling process, toxic gasses — such as nitrogen dioxide ($N0_2$) and nitrogen tetroxide (N_20_4) — are produced, which may form a brown gas on top of the silo. This gas, which is heavier than air, has caused permanent lung damage in people as well as killed both livestock and humans. These silo gasses can float down a silo chute and into a barn or confined area. Whenever toxic gasses are a possibility, care must be taken to protect both humans and animals. Make sure that enclosed areas around the feed storage area (feed rooms, silos, animal pens, etc.) are well ventilated and safe before entry. Doors and windows to enclosed areas should be opened, and silo blowers should be run before any attempt is made to enter a silo. If there is any doubt about toxic gasses being present, an oxygen mask should be used in and around the feed storage area. Oxygen masks and respirators may be available through the local fire department.

Green chop and hay harvested from drought-stressed crops such as corn, sorghums and millets grown on highly fertilized soils pose the greatest risk of elevated nitrates. Nitrate accumulation in corn harvested as green chop or hay in a normal year is typically not a significant factor, but the risk increases when it is harvested following a droughty period. Drought-stressed crops, and especially when drought stressed crops are harvested shortly after a rain, can be very high in nitrate. It is recommended to wait 7 to 10 days following a rain before harvesting drought-stressed forages that are suspected of containing high nitrate concentrations. Drought stressed oat harvested as hay from land that received a heavy nitrogen fertilizer application, and rain just prior to harvest (which encourages nitrogen uptake), has caused cases of both acute and chronic nitrate poisoning. When elevated nitrates are a concern, introduce the suspect feed slowly into the ration. This can be done by initially feeding small quantities and increasing the amount fed over the next 7 to 10 days to allow rumen adaptation. When feeding green chop, raising the cutter bar to 12 inches for the first few days of harvest and after a rain are recommended to eliminate harvesting the bottom of the stalk where nitrates are in highest concentration.

Harvesting corn as a hay crop can be potentially dangerous and it should be done with extreme caution. Nitrates do not dissipate during the drying process. Additionally, dry hay contains less moisture and is consumed (dry matter basis) more rapidly than a fresh forage. It has been estimated that dry hay releases 80% of its nitrates in the first 20 minutes after consumption, while fresh forages releases only 30% over the same time period. Therefore, the likelihood of nitrate toxicity increases when feeding one large round bale harvested from an area in the field with high nitrate concentrations compared to feeding silage, limit fed green chop, or grazing. The reason for this is that limiting intake of large round bales can be difficult and there is less opportunity to dilute intake of a high nitrate feed with other low nitrate feeds. Limiting access time to large round bales is one option and it was discussed under item 11 above. The standing crop should be tested for nitrates before cutting. If the nitrate concentration is high, delay harvest and test again in several days. When sampling plants before cutting for hay, it is recommended that several samples be submitted for nitrate analysis to reflect poorest, better and best corn areas in the field. It may be necessary to delay, or avoid, cutting some areas of the field to minimize the challenges associated with high nitrate containing feeds. Feeding high nitrate corn as a hay crop can be done safely if it is introduced slowly into the diet and diluted appropriately with low nitrate feeds.

The nitrate concentration that causes toxicity in ruminants varies depending on rate of intake, dietary components, rumen acclimation to nitrate, stage of production, and nutritional status of the animal. Animals in good condition fed a nutritionally adequate diet are less susceptible to nitrate toxicity than either animals in poor condition or nutritionally stressed animals. As a rule of thumb, forages containing less than 5,000 ppm NO_3 on a dry matter basis are considered safe for most classes of beef animals. Forages containing 5,000 to 10,000 ppm NO_3 are considered potentially toxic when provided as the only feed. Forages containing over 10,000 ppm NO_3 are considered dangerous. The only way these higher nitrate containing feeds can be fed safely is to limit their intake and diluting them with low nitrate containing feeds.

Laboratories report nitrate content of feed and water in different forms. Consider the form for expressing nitrate levels to avoid errors in determining the potential for toxicity. Table 6 should aid in interpreting laboratory results.

Table 6: Equivalent levels of nitrate.

Nitrate (NO_3)		**Nitrate-nitrogen (NO_3-N)**		**Potassium nitrate (KNO_3)**	
ppm[1]	**%**	**ppm**[1]	**%**	**ppm**[1]	**%**
200	.02	46	.0046	326	.0326
5,000	0.5	1,150	.115	8,150	.815
10,000	1.0	2,300	.23	16,300	1.63

[1]parts per million

If there is concern about nitrate levels in feeds, consider the following:

1. Remember that thin cattle in poor health, or cattle suffering from respiratory distress are more susceptible to nitrate poisoning than moderately conditioned cows fed a nutritionally adequate diet.
2. Gradually introduce cattle to suspect forages over 7 to10 days. The objective is to give the rumen microbes an opportunity to adapt to the higher nitrate intake. Never allow hungry, unadapted cattle access to suspect feeds. Take time (one to three days) to make sure cattle are full and consuming a significant quantity of a bulky, low nitrate forage (such as good-quality grass hay), and then introduce suspect feed slowly into their diet over the next 7 to 10 days all the while keeping them full with low nitrate feeds.
3. Dilute suspected high-nitrate feeds with low-nitrate feeds. Dilution is one method that can not only help rumen microbes adapt to high-nitrate feeds, but also maintain a safe level of nitrate intake for the animal. Suspect feeds can be blended with low-nitrate feeds such as grass hay, crop residues or grain supplementation. Feeding 2 to 3 pounds of dry corn, distiller’s grains, corn gluten feed or soybean hulls per head daily has the additional benefit of providing extra energy to stimulate microbial conversion of nitrate to non-toxic nitrogen compounds in the rumen.

4. If drought-stressed corn, sorghum or millet is to be made into hay or green-chopped from high-fertility soils, it should be tested for nitrates before harvest - especially if the crop experienced a short period of rapid growth, due to improved environmental conditions, just prior to harvest.
5. When using suspect forages such as green chop, harvest only the amount to be fed immediately. Storing green chopped forages on wagons for later use can result in feeds that are significantly more dangerous because of the conversion of nitrate to nitrite, which is substantially more toxic than the original nitrate. When first introducing green chop into a ration, raise the cutter bar to at least 12 inches when harvesting during the first few days to reduce high nitrate levels associated with the accumulation in the lower stalk. Once feeding green chop, raise the cutter bar to 12 inches or more following a rain when nitrate concentrations would be expected to increase. Feeding green chop twice per day vs. one larger feeding will also help the rumen adapt and minimize the negative effects of nitrate.
6. When grazing high-nitrate forages, provide a palatable, low-nitrate hay or grain supplement to dilute the nitrate. In addition, consider limiting the grazing time of suspect forages for the first six to eight days, increasing the grazing time a little each day. For example, allow cattle to fill their rumens with hay for several days and then initiate grazing high-nitrate forage for less than an hour on the first day with free-choice access to a low nitrate hay during the remainder of the day to fill the rumen. On day two, increase their grazing time to an hour plus free-choice hay. Each subsequent day continue to allow animals free-choice access to hay and increase grazing time by approximately one half hour per day until cattle reach at least 8 hours of grazing per day. Once cattle reach a grazing bout of over 8 hours per day, it can be assumed the rumens are adapted and they can remain on the high nitrate containing forage all day if a low nitrate, diluter feed (hay or grain) is also available free-choice. Remember, nitrate levels are highest during the first several days after a drought-ending rain and then come down over the course of the next 7 to 10 days as plant metabolism returns to something approaching normal.
7. When grazing suspect forages, stock lightly so animals can selectively graze the leaves, and husks that have lower nitrate concentrations. Avoid overgrazing of high nitrate potential corn plants to minimize animal intake of the lower stalk where nitrates tend to accumulate. Not all cows follow this logic and some will devour an entire plant, and especially when stalks are small. In fields where shoots contain some grain, adapt cattle to corn before turn-out to minimize the potential of acidosis.
8. Avoid using ionophores (Rumensin® or Bovatec®) in rations that have the potential of containing high nitrate concentrations. Ionophores reduce the acetate:propionate ratio in the rumen and it has been reported that this reduction, combined with the reduction caused by the presence of nitrates, can cause a rapid shift in microbes to those that produce nitrites, as well as an increase passage rate of nitrites into the blood stream.
9. Animals suspected of nitrate poisoning should be kept as calm as possible to minimize respiratory distress and a veterinarian should be called immediately to formalize a diagnosis and intravenously administer methylene blue as an antidote.
10. Provide large quantities of fresh drinking water. Water dilutes nitrate concentrations in the rumen and helps to not only reduce the potential of toxicity, but also helps reduce heat stress and associated respiratory distress.

14. Graze Crop Residues and Stockpiled Forages to Reduce Harvested Feed Needs.

As previously discussed, harvesting wheat straw and corn stover, when available, can be used to extend limited forage resources. There is no question, however, that grazing corn stover in the field is more economical than mechanical harvesting. Review pesticide labels used to make sure that the crop residues can be fed to beef cattle and that the harvest restriction time has been exceeded before mechanical harvest or grazing occurs.

A strategy of how corn stover grazing might fit into a winter feeding program needs to be developed for each beef operation. Grazing corn stover should be done in areas that meet state law requirements for a perimeter fence and that has adequate water available. A single "hot" wire may be an adequate internal, or division fence if cows have been trained to respect an electric fence, but should not be used as a perimeter fence. Ideally, corn fields should be strip grazed using "hot" wire division fences to maximize the use of the stover, and to minimize trampling of the shucks and leaves.

There is always risk of nitrate toxicity in drought stressed corn stover, but the risk is significantly lower than when feeding the forage as green chop or hay. The reason is that cows will often avoid eating dry, course stalks if they are given the opportunity to selectively graze leaves and shucks. If producers graze stalks, they should watch and move cows before all the leaves and shucks have been removed. If making baled stover, cows should be given the freedom to sort and leave the bottom of the stalk in the hay feeder. If cows are starved to them they will eat the bottom portion of the stalk, therefore, do not force them to cleanup before refilling the feeder. Any refused material can be used as bedding. Again, transition the cows to nitrate containing feeds slowly and provide cows with a low-nitrate feed for dilution.

Corn plant residues are highest in nutrient value in early harvested corn immediately following the combine. During the 30 day period following grain harvest, a mid-gestation, spring-calving beef cow can probably meet her nutrient requirements if provided free-choice access to a high-quality mineral mix and water. Forage quality declines with time following harvest due to weathering and selective grazing, and there will be an increasing need to provide supplemental energy and protein supplement. When grazing or feeding low-quality forages, cow body condition should be monitored closely and supplement strategies adjusted accordingly.

When harvesting grain, consider disengaging the chopper on smaller combines to allow shucks and cobs to fall directly behind the combine in two or three rows. Since shucks and leaves have more nutrient value and less potential nitrate accumulation than the stalks, this will help minimize their deterioration. If corn residues are to be mechanically harvested, consider baling only those two or three rows directly behind the combine where the shucks and leaves were dropped. This will provide a higher quality forage resource with a lower nitrate concentration compared to harvesting all residue material in the field. A side benefit of leaving some residue in the field is soil erosion control.

If rains return before late August in a drought year, fall regrowth of cool-season grasses can be increased by applying 50 pounds of nitrogen per acre before late August. In normal years, this practice works well for stockpiling a forage resource that can be used in late fall to extend the grazing season. If urea is the nitrogen fertilizer of choice, it should be applied when rain is predicted since urea volatizes to the atmosphere in hot, dry weather.

15. Provide Clean, Cool Water to Reduce Heat Stress and Maintain Herd Health.

During droughty conditions, the moisture content of grazed forages will be significantly lower than during a normal year. Cattle will drink considerably more water when environmental temperatures are high, dietary ingredients are low in moisture content, and cows are lactating. Provisions need to be made to accommodate this increased water consumption and free-choice access to clean, fresh water is extremely important to support not only adequate feed intake, but also to maintain animal performance and health. Stagnated stock ponds and creeks under drought conditions are often murky and contaminated with high nutrient levels, microbes and algae which can affect water intake and animal performance. Producers in this case may need to resort to finding alternative water resources that will allow cattle to perform at their potential. In some cases, it may be necessary to obtain water from a well located onsite or offsite and hauled to the cattle. Providing cool, fresh water during hot weather can also serve to help lower the body temperature of heat-stressed cattle.

16. Add Moisture Around Electric Fence Ground Rods.

As pasture resources are depleted, cows will be looking for greener pastures, and that is often across the fence. Electric fences require good, functional ground rods to be effective. In a hot, dry environment, it is often necessary to add moisture to the area surrounding electric ground rods for the fence to work properly. Neglect in this area increases the risk of cattle escapes and liability.

Summary

When faced with a limited forage supply, there are a number of feeding and management strategies to consider, both individually and in combination. Each operation should develop a strategy that helps control costs, maintains optimal animal performance, and preserves profitability into the future.

Contact information:

Ron Lemenager, PhD, PAS
Purdue Animal Sciences
Ph: 765-494-4817
Email: rpl@purdue.edu

Keith Johnson, PhD
Purdue Agronomy
Ph: 765-494-4800
Email: johnsonk@purdue.edu