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DROUGHT TIP

Supplemental Feeds for Cattle Operations during Drought

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One of the advantages of cattle production in California is the diversity of feeds available in times of need to supplement rangeland that is normally used for cattle. In most cases, supplementing with alfalfa or a combination of alfalfa and small grain hay is the easiest method to meet protein, energy, and calcium requirements when rangeland nutrients are depleted due to drought. When the market prices of these traditional hay supplements become high, it becomes necessary to consider alternative feed sources. These alternative supplemental forages include high-nutrient concentrates and fiber-based roughages, making it possible to form a complete ration to satisfy the nutrient and dry matter intake requirements of cattle.

The prices of these feeds vary, so check the costs each time a supplemental ration is being formulated. It is likely that the same supplemental ration will not be used two years in a row. A ration balancing program such as Taurus, offered by the University of California, Davis, Department of Animal Science (see http://animalscience.ucdavis.edu/extension/Software/), is a great tool for developing the lowest-cost supplement that meets the nutrient requirements of the particular class of cattle being supplemented.

All supplemental feeds have advantages and disadvantages. Before feeding, contact your local UCCE Farm Advisor or other cattle producers, including dairymen, who have likely tried many of the local by-product feeds.

Careful control of diets and feed management practices will be required, as the following aspects of supplemental feeds may affect animal performance:

- Possible mycotoxin contamination may exist, particularly in fermented feeds (e.g., distillers' grains) and feeds not stored properly.
- Mineral content of some feeds (corn gluten, distillers' grains, etc.) may be very high.
- Greater than 7% dietary fat in some feeds (cotton seed, rice bran, distillers grains, etc.) can depress dry matter intake.
- High moisture levels in feeds increase transportation costs, encourage fermentation, create difficult handling and storage, and can attract insects.
- Lack of fiber in the ration (starch, molasses, whey, permeate, etc.) can contribute to rumen acidosis; excess fiber in feeds (straw, raisin tailings, wheat bran, etc.) can decrease dry matter intake.
- Some feeds are relatively unpalatable or may be fermented, affecting palatability (mycotoxins).
- Crude protein content can be highly variable in some by-products, affecting cattle reproduction, feed efficiency, and weight gain.

Concentrates

Rice Bran

With 13% fat content (table 1), rice bran historically has been used as an energy feed. It also contains protein, B vitamins, and high levels of readily available phosphorus, but it is low in calcium. Rice bran should not exceed 20% of the ration, as high amounts of unsaturated fats can lower cellulose digestion can impact fat metabolism and absorption rates. Animals fed too much rice bran commonly go off feed or scour. To limit intake on range operations, salt can be added to the rice bran. To avoid over-consumption, monitor consumption rates and adjust salt levels to reach the desired intake. Added salt can increase water consumption, which may be critical to address during a drought year. A starting mix could be 50% salt and 50% rice bran. Producers with hammer mills have simply poured rice bran over the top of baled hay before adding to the mill for processing. For more information, see *Limiting Feed Intake with Salt in Beef Cattle Diets* (Berger and Rasby 2011).

Almond Hulls

Almond hulls are similar to grass or grain hay as a source of energy but are lower in protein (3% crude protein). They can be fed in troughs, or a hot electric fence wire can be placed on the edge of a stack of hulls and moved in as the cattle consume them (there is some waste of the product with this method, but it saves labor and infrastructure costs). The major problem with the purchase of hulls is that some processors sell loads of hulls that may contain low-nutrient contaminates of shell or twigs. It is prudent to get a purity percentage and/or nutrient testing before comparing price

Table 1. Average nutrient values (%) for selected concentrate energy sources

	Dry matter	Crude protein	ADF	TDN	NDF	Ash
rice bran	91	14	18	71	24	11
almond hulls	89	3	28	56	36	7
canola meal	90	41	16	72	29	8
walnut meal	93	17.1	34	67	—	5
safflower meal	91	24	41	56	57	6
pinto beans	90	25.2	6	83	12	4.8

Source: Bath et al. 1980; Nutrient Requirements of Beef Cattle, 7th ed.

quotes on almond hulls. Shells in the almond hulls can cause bowel impaction and death in cattle and should be avoided even if the price is discounted. See the appendix to this publication for the legal standard for the sale of almond hulls or shells.

Oil Seed Meal

Various oil seed meals are commonly used for livestock feed. These feeds are residues (or by-products) from the production of cooking oil, and they are high in both protein and energy. Canola, cottonseed, and soybean meal have been successfully fed to cattle, especially in dairies that purchase pelleted canola meal. Feed mills and brokers are common methods of locating this and other dairy feeds one might consider for supplementing beef cattle during times of drought.

Beans

Cull beans rejected for human consumption may be sold as livestock feed. Although they are high in protein and energy, beans should be limited to 2% or less of cattle diet to avoid diarrhea. Consumption in excess of 2% of the diet can also inhibit protein digestion due to the lectins found in beans. In addition, beans that have not been roasted are generally unpalatable to cattle.

Corn

Though traditionally rejected as too expensive, corn often comes down in price and should always be considered due to its extremely high energy value. In previous droughts, corn has been used to spare limited hay supplies. The general rule of thumb is that 1 pound of corn will replace 2 pounds of alfalfa or 3 pounds of meadow hay. The challenge for range operations is finding a way to feed corn at the ranch. Troughs or feeders work best. To avoid related costs of troughs and infrastructure, ranchers have been very innovative in finding alternative techniques for feeding fine-textured feeds. One rancher bought a used 3-foot-wide conveyer belt from a Nevada mine and used a feed wagon to distribute the grain down the conveyer belt, as if it were a feed bunk. The rancher added a connection to one end, which allowed him to pull it to different locations around the ranch. Storage also needs to be addressed because corn stored without another grain in the mix will spoil quickly in a silo-type storage system.

Roughages

The most traditional source of roughage supplementation on rangeland is alfalfa hay, which is also commonly the lowest-cost source of protein on a per-pound basis. Alfalfa hay is also a good source of energy (TDN; see table 2). Although lower in protein, small grains such as wheat and oat hay can provide supplemental TDN in a roughage form that may be an adequate winter energy source for spring-calving cows, which are not lactating during the winter season. Small grain hays are generally too low in both protein and energy for feeding to lactating or growing cattle.

Table 2. **Nutrient values (%) for selected roughage sources**

	Crude protein	ADF	TDN	Ash
alfalfa	17	36	58	9
corn stover	5	43	54	7
kidney bean straw	9.9	43	58	10.4
lima bean straw	7.6	39	55	9.3
oat hay	10	39	54	8
rice straw	4	55	44	16.6
wheat hay	9	38	57	8
wheat straw	3	57	43	8

Source: Bath et al. 1980; Nutrient Requirements of Beef Cattle, 7th ed.

Rice straw can be treated and baled at high moisture to increase intake and prevent mold formation. Photo: Josh S. Davy.

During severe droughts or when traditional hay sources are limited or expensive, rice straw and corn stover (baled corn stocks) have been used as low-quality forage. Before purchasing either of these products, a complete feed analysis should be conducted by a certified laboratory. Comparing feed analyses can help you select a product of higher nutrient value that will decrease supplement costs to meet cattle needs.

If you are sampling stacks of baled straw after harvest to determine whether the straw meets nutrient quality specifications, take 25 core samples around the stack and place them in one labeled bag, then mail the bag to the laboratory for analysis. Hay sampling probes can be purchased online or locally in farm stores. Have the samples analyzed for crude protein (CP), energy (TDN), and acid detergent fiber (ADF), a laboratory method of determining the fiber content that can assist in predicting the digestibility of feed. A lower ADF value leads to a more digestible feed. More detailed information on testing forage quality is available on the University of California's Alfalfa and Forages Workgroup website, http://alfalfa.ucdavis.edu.

As the primary agricultural purpose of this forage was not livestock feed, ask the grower about herbicides, desiccants, and pesticides that were applied to see whether their presence restricts your ability to use the straw for feed.

Rice Straw

A survey of over 70 harvested rice straw stacks found large variances in crude protein (2 to 7%) and ADF (44 to 55%). Although research has not been able to completely explain the reasons for the variability of rice straw nutrient values, it has narrowed down some of the factors that may influence quality. These variables include the number of days baled after harvest, nitrogen management, location or soil type, and the variety of rice.

With a dietary requirement of only 7% CP, a non-lactating beef cow has the lowest nutrient requirement of most classes of cattle. Rice straw fails to meet even this crude protein level. The lower the CP percentage of the straw, the higher costs will be for concentrate feed additives necessary to meet the cow's nutritional requirements. For this reason, the University of California has developed nutritional testing recommendations for rice straw to enable purchasers to optimize the beef cattle performance and intake when feeding rice straw as a part of the diet. Forage quality of rice straw used for livestock feed should meet the following criteria:

- CP 4.5% or higher
- ADF 50 % or lower
- moisture 12% or lower

For more information on rice straw, see Berger and Rasby 2011; Drake 2002; and Nader and Robinson 2010a and 2010b.

Corn Stover

To feed corn stover (baled corn stocks), place the bales in feeders. Placing corn stover as free choice in the field creates more waste than with rice straw. Corn stover that has the stocks chopped before baling increases complete consumption. Cattle being fed corn stover can develop high levels of nitrate, especially if they are also being fed non-protein nitrogen supplements. Excessive nitrate consumption

Cattle at a feed bunk eating high-moisture rice straw. Photo: Glenn A. Nader.

Cattle in a drylot being fed bean straw. Photo: Josh S. Davy.

Table 3. Associated risks of nitrate levels in water and feed

Level	Risk
Water, ppm (parts per million) nitrate (NO_3)	
0–44	not harmful
45–132	slight possibility of harm
133–220	risky over long period of time
221–660	some losses expected
661–880	increased losses expected
880 and above	heavy, acute losses
Feed, % nitrate nitrogen ($NO3^-N$) content	
0.0–0.1	safe under all conditions
0.1–0.15	safe for cattle EXCEPT pregnant cows
0.15–0.4	increasing level of risk; limit amount to keep total diet below 0.15% of nitrate nitrogen
over 0.4	do not feed

Source: Maas 2001.

by cattle can inhibit the flow of oxygen to major organs of the body, causing death. Corn stover should be analyzed for nitrates to allow for prudent management of feed for the safety of the cattle. Consult the guidelines in table 3 for interpreting an analysis of feed and water nitrate levels. The units reported in an analysis must match the units in table 3; if they do not, convert them for proper interpretation.

Bean or Pea Straw

Farming operations that grow peas or beans for human consumption have residue (straw) that can be baled after harvest. The material is dry, and ranchers report that cattle intake slowly increases as cattle get accustomed to it as a forage. Growers who use drip tape in the crop field may be concerned about soil compaction during the baling process. Keeping the baler and harrowbed tires in the down furrows can minimize the impacts.

Rice Strawlage

University research has demonstrated that traditional rice straw decreases in digestibility by about 27% during the drying process. An experimental process of baling rice straw behind the harvester at 50% moisture to preserve quality was conducted for three years. At baling a product containing propionic acid and a buffer to prevent baler corrosion was sprayed onto the straw as it entered the baler.

The bales in the stack go through a sweat, with temperatures around 130°F degrees for the first few days after baling. The stacks must be properly tarped to limit the entry of oxygen and subsequent combustion. The temperature in the stack dropped to approximately 90°F, and the product was fed at 30 to 45 days. Cattle intake of the straw was increased over dry straw, and current data indicates an increase in available energy.

Baling rice straw as a high-moisture "strawlage" product is a new practice. Further research is required: mold formation throughout the stack and water condensation on the top bales under the tarp are two challenges that must be addressed. Nitrogen in the form of urea applied to individual bales at harvest has shown some promise in deterring mold and increasing cattle intake, though the process is labor intensive. Likewise, ammoniation of the stack after tarping appears to decrease mold and highly increase intake and crude protein. Current University of California research is testing many different rice straw baling practices to increase straw quality and palatability, with results expected in the next few years.

Supplemental Feeding

Supplemental feeding during drought, including byproducts and nontraditional feed sources, is a very real option to avoid complete herd liquidation. It can become a practical management option if the logistics of feeding, storage, and transportation are accounted for. When considering or preparing to supplement with alternative feeds, seek guidance from those with experience feeding the products, including other cattle producers, dairymen, and your local UCCE Farm Advisor.

Appendix: California Legal Standards for Almond Hull Products

2773.5. Almond Hull Products.

(a) Almond hulls are obtained by drying that portion of the fruit which surrounds the nut. They shall not contain more than 13.0 percent moisture, nor more than 15.0 percent crude fiber, and not more than 9.0 percent ash. If they contain more than 15.0 percent but less than 29.0 percent crude fiber, they shall be labeled "Almond Hull and Shell", and the maximum percent of crude fiber shall be stated. If the crude fiber exceeds 29.0 percent, the product shall be labeled "Almond Shell". If the ash exceeds 9.0 percent, the term "and dirt" shall be included in the product name. Almond hull products shall be free of foreign material, including plastic, glass, and metal except in such trace amounts as unavoidably occur in good manufacturing practices.

(b) When the following almond hull products are used in a mixed feed, the maximum percent shall be stated. (1) Almond Hull and Shell (2) Almond Shell (3) Almond products containing more than 9.0 percent ash.

Authority: Sections 407 and 14902 of the Food and Agricultural Code

Cattle consuming a concentrate supplement on annual rangeland.
Photo: Josh S. Davy

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