Feeding Whole Soybeans and Drought- or Frost-Damaged Soybeans to Beef Cattle

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High-quality soybeans and damaged soybeans can serve as an excellent source of energy and protein in beef cattle rations and supplements. All too frequently in Oklahoma, late summer heat and drought result in a significant proportion of the soybean crop being damaged in terms of size, color, weight, and nutrient content. This damaged grain may not be merchantable at many grain elevators, or if the damage is only moderate, it may receive a severe market discount. Consequently, beef cattle producers should consider the opportunity to incorporate soybeans into their feeding programs when the soybean market is depressed or when drought- or frost-damaged soybeans are available at low prices.

Nutrient Content and Animal Performance

Whole soybeans typically contain 38 to 42 percent crude protein and 16 to 20 percent fat (dry matter basis). However, drought-damaged soybeans — particularly green-colored beans — generally have lower protein (anywhere from 25 to 38 percent) and fat (14 to 18 percent). Consequently, as in most animal feeding situations where uncommon or variable feedstuffs are used, a nutrient analysis from a commercial laboratory is advised.

Whole raw soybeans have been shown to be an effective protein supplement compared to soybean meal in a low-quality hay diet (6.5 percent protein) for growing steers in one Oregon study. In a Kentucky study, growing steers were fed whole soybeans or soybean meal as the protein source in corn silage rations. Weight gain and feed efficiency was similar for both protein sources.

When whole soybeans are fed to cattle receiving a roughage-based diet, cattlemen have noticed that some of the beans apparently escape digestion and are passed through the feces. In order to quantify the feeding value of whole and rolled drought damaged soybeans, a winter study was conducted with gestating beef cows. The treatment period was initiated on November 11, 2000, and continued through the beginning of the calving season, February 2, 2001, for a total of 88 days. Supplement treatments are shown in the table and consisted of whole soybeans, rolled soybeans, a more traditional supplement formulated with soybean meal and soybean hulls, and a non-supplemented (Control) group. The "traditional" treatment was formulated to deliver equal CP and calories or TDN compared to the whole and rolled soybean treatments. The drought-damaged soybeans graded U.S. No. 4, and they were small with approximately 40 percent having a green color.

Initial average cow weight in November was 1,227 pounds with average initial body condition score of 5.25 on a scale of 1 to 9, with 1 being extremely thin and 9 being obese. Supplemented cows were fed two times the daily feeding rate every other day. Cows had access to stockpiled winter range (consisting primarily of native warm season grass species), and were fed prairie hay (5 percent CP) during inclement weather. After February 2, the cows were group fed the equivalent of 3 pounds per head per day of a 38 percent crude protein supplement until supplementation was not necessary due to abundant green forage growth.

Results from this experiment confirm previous studies demonstrating the importance of protein supplementation.

Table 1.

	Treatment[a]			
Item	*Whole soybeans*	*Rolled soybeans*	*Traditional supplement*[b]	*No supplement*
Feeding rate, pounds per day	2.0	2.0	2.75	-
CP, pounds per day	0.77	0.77	0.78	-
TDN, pounds per day	1.95	1.95	2.0	-
No. of cows	22	25	23	21
Cow weight change, 88 day late gestation feeding period, pounds[c]	-58	-17	23	-153
Calf birth weight, pounds[c]	84.8	84.6	88.5	77.5
Calf weaning weight[c]	493	494	484	448
Pregnancy rate, %	95	96	83	81
Average milk production, pounds per day[c]	18.6	16.3	15.0	14.0

[a]Treatments were fed for 88 days during late gestation (through Feb. 2). All cows were fed 3 pounds per day of 38 percent CP supplement from Feb. 3 through spring green-up.
[b]Traditional supplement contained 45 percent soybean meal and 55 percent soybean hulls.
[c]Treatment effects are significant ($P < .05$).

Cows that received the traditional supplement weighed 176 pounds more at the beginning of the calving season compared to cows that were not supplemented. Some of the dramatic difference in weight change, spring and summer milk production and the resulting difference in calf weaning weight may be due to the extreme wet, cold conditions of the winter of 2000/2001. Other research has shown that cattle respond more to supplementation during hard winters.

Cows that received the traditional supplement weighed 40 pounds more at the beginning of calving compared to the cows receiving rolled soybeans. Calf birth weight, calf weaning weight and milk production was very similar between these two groups. Pregnancy rate of the rolled soybean cows was numerically higher, although this difference was not statistically different.

Cows that were fed rolled soybeans weighed 41 pounds more at calving, compared to cows fed whole soybeans. All other production measures were very similar between the two groups, however.

From these data, it is apparent that drought damaged soybeans can be a cost effective winter supplement for beef cows. There appears to be some advantage to processing the soybeans, in terms of cow weight change during winter. However, the difference in cow winter weight change did not significantly affect important economic factors.

Whole soybeans have also been shown to be an effective protein and fat supplementation source for feedlot cattle. In a Missouri study, whole raw soybeans were included at the rates of 0, 8, 16, or 24 percent of the ration dry matter. Soybean meal was used to achieve equal crude protein supply for each treatment. No differences were found in rate of gain, feed efficiency, or carcass characteristics among the treatments.

Precautions and Considerations

Raw soybeans should not be fed to calves less than four months of age or weighing less than 300 pounds. Nor should they be fed to non-ruminant animals. The primary concern is a trypsin-inhibiting compound that renders dietary protein indigestible. Trypsin is a digestive enzyme that is vital for the digestion and utilization of dietary protein. The inhibitor found in raw soybeans is rendered inactive in larger ruminants because of the detoxifying ability of ruminal fermentation. The trypsin-inhibiting compound is also destroyed through heating or cooking of the soybeans, as is done in the soybean milling process.

Raw soybeans should not be fed to animals receiving a diet containing urea. Soybeans contain the enzyme urease, which breaks down urea into ammonia at a very rapid rate. Toxicity occurs when the rate of ammonia entering the bloodstream overrides the liver's capacity to filter it out.

Another consideration is that processed soybeans will become rancid in a *shorter* period of time compared to unprocessed, whole soybeans. This is particularly true during warm weather. Therefore, *during the summer months*, cracked, rolled, or ground soybeans should be fed within *three weeks* after processing.

The amount of whole soybeans fed should be limited to around 0.3 percent of the animal's body weight. For example, a 500-pound steer should receive no more than 1.5 pounds of whole soybeans per day. This will ensure that total fat concentration in the diet does not hinder digestion of other ingredients and create digestive scours. Fat content of beef cattle diets should not exceed 6 percent. Most other feed grains and forages contain between 2 and 4 percent fat.

Remember to consider the vitamin and mineral balance in the total ration. Vitamin A may be of particular importance this year with the drought and heat stress that forages and cattle have endured. High-fat rations tend to slightly hinder calcium and magnesium absorption, so if soybeans are fed at near maximum rate (0.3 percent of body weight), feed or free-choice mineral supplements should be formulated to contain calcium and magnesium in amounts that are slightly higher than normal.

When should you consider feeding whole soybeans?

By using current prices for corn and soybean meal, one can estimate the soybean price at which whole soybeans could be substituted at a breakeven level. Approximately 67 pounds of 48 percent soybean meal, 30 pounds of corn and 3 pounds of vegetable or animal fat contain equal protein and energy as 100 pounds of whole soybeans. This relationship is used to calculate the breakeven substitution soybean price in Table 2. In the case of small or green soybeans, around $.40 to $.50 per bushel should be added to the breakeven price to account for the cost of processing.

Summary

Whole soybeans and drought- or frost-damaged soybeans can be useful nutrient sources for beef cattle. Occasionally, they can be used to cheapen ration costs for grazing and feedlot cattle. However, the amount that can be added to beef cattle rations is limited because soybeans contain high concentrations of fat. Producers should also heed the various other precautions and considerations noted above before feeding this concentrated source of energy and protein to cattle.

Table 2. Prices at which whole soybeans could be substituted for an equivalent blend of soybean meal, corn, and fat*.

	Corn price, $/bu				
SBM price, $/ton	2	2.5	3	3.5	4
	Soybean price, $/bu				
175	4.88	5.03	5.18	5.33	5.48
200	5.39	5.54	5.69	5.84	5.99
225	5.89	6.04	6.19	6.34	6.49
250	6.39	6.54	6.69	6.84	6.99
275	6.89	7.04	7.19	7.34	7.49

*Calculated based on 100 pounds of whole soybeans containing equal protein and energy to 67 pounds of 48 percent soybean meal, 30 pounds of cracked corn, and 3 pounds of vegetable oil or animal fat. Vegetable oil price is assumed to be $350 per ton, and a $15 grinding and mixing charge per ton is included.

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