

Soybeans as Forage for Dairy Cattle

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Drought conditions will force dairy producers to look for alternatives to feed as forages. Oilseeds, such as soybeans, may be harvested for forage when drought conditions have shrunk soybean yield below the economic threshold for harvest or when facing a forage shortage. Alternative forages, like soybean haylage or hay, can help stretch usual forage supplies whose yields are likely compromised as well.

During a drought, one concern is availability of protein sources to balance the ration. Soybeans are a legume, therefore, when harvested as forage contain greater amounts of crude protein (CP) compared to corn silage and small grain silages. How this crop is harvested for forage will depend on the individual crop and its maturity stage.

The major limitation of using soybeans for forage is that only a few herbicides are cleared for use on soybeans harvested for forage. If the decision to harvest soybeans for forage is made after a herbicide application that is not cleared for use, it is not legal to do so. Some herbicides having clearance for feeding soybean forage to cattle are included in Table 1. Always verify herbicide restrictions when using soybeans for forage by checking the label for information because some herbicides are not approved for use on crops that will be fed to livestock (forage). Also, be sure to follow withdrawal recommendations for herbicides allowed for use on soybeans for forage (Table 1).

Baled Soybeans (Hay)

Soybeans harvested for forage can make great feed. The nutritive value of a soybean plant can be comparable to early-bloom alfalfa (high protein and very digestible). Lactating dairy cows (Varga-Bello-Perez et al., 2008) and growing heifers can have similar performance when given either soybean hay or alfalfa forage (Reid, 2001). Palatability is usually not a concern when feeding soybean forages unless the forage is moldy or dusty.

Cut soybeans when pods are almost full of seed and lower leaves are just starting to turn yellow, but are not falling off. Stems tend to dry slowly; conditioning will achieve a similar dry down rate between the stems and leaves to achieve total plant moisture below 25%. Rake no more than needed, as leaves and pods tend to shatter easily.

Once the plants begin to lose their leaves, it may be too late to make hay. The transition from what looks like a good crop and a dead crop can be just a few days.

Soybean Haylage (Silage)

Moisture content is important when ensiling as haylage or balage. Recommendations are similar to alfalfa silage (35-45% dry matter (DM)). For soybeans, this is right before the pods are full. Waiting until complete maturity results in forage of lower digestibility and can lead to fermentation problems due to the high oil content of the seeds.

Direct-cut soybeans may have DM concentrations between 22-30%. Ensiling at this moisture will result in higher effluent losses and a greater risk of undesirable fermentation (butyric acid). Generally, it is better to target 35-40% DM or 60-65% moisture.

Buffering capacity of the crop is relatively high, potentially resulting in fermentation problems. The use of a good inoculant (silage fermentation aid) should aid in reducing these problems and ensure mold growth is kept in check.

Nutrient composition from 20 soybean haylage samples fed in lactating dairy cow rations (Dairy Farm Samples) are shown in Table 2. As described, the CP concentration can be greater than most other forages, such as corn silage and small grain silages, averaging approximately 19%. Harvesting at earlier maturities will likely increase CP concentrations, but will depend on the soybean development stage. High concentrations of CP make soybean haylage even more valuable as both a forage and a protein source relative to other ingredients.

The soluble protein concentrations of soybean haylage, as a percent of CP, can vary from low to high. These values may be correlated with the DM content of the harvested material (i.e., the higher the moisture the higher the soluble protein). But, higher soluble protein concentrations do present the opportunity that soybean haylage fits well with corn silage based rations.

Fiber (neutral detergent fiber [NDF], acid detergent fiber [ADF], and lignin) and non-fiber carbohydrate (NFC) concentrations will vary in relation to the maturity at which the crop is harvested. However, soybean haylage can range from being a lower fiber, higher NFC to a higher fiber, lower NFC crop. However, the *in vitro* DM digestibility (IVDMD) of soybean haylage from 61-77% (Table 2) with NDF digestibility (NDFD) ranging from 36.6-47.8% (for a 30-hour measurement) makes soybean haylage a very good digestible forage when harvested at the appropriate time. Mustafa et al. (2007) reported soybean cultivar can have an influence on nutrient composition and ruminal nutrient degradability.

The fat concentration ranges from a low of 2.3 to a high of 6.6%, which is going to vary upon the development of the soybean in the pods. Obviously, the greater the soybean seed development in the pods, the greater the fat concentration will be. Ash and mineral contents vary somewhat, as well maturity and quality. Nevertheless, soybean haylage can be a good source of calcium and phosphorus

Table 1. Herbicides prohibited or allowed for use on soybeans for forage (grazing, hay, and haylage).

Prohibited	
Assure II	Lorox & Butyrac 200
Blazer	Pinnacle
Bugle	Pursuit
Canopy	Scepter
Classic	Scepter O.T.
Command	Select
Freedom	Sonalan
Fusilade 2000	Squadron
Lasso Micro-Tech	Strom
Linex & Butyric 200	Tri-Scept
Allowed	
Arena	Poast Plus (hay only)
Basagran	Prowl
Bronco	Roundup
Dual	Salute
FirstRate	Sencor
Lasso E.C.	Tri-4
Lexone	Trilin
Poast (hay only)	Turob

Table 2. Nutrient composition of soybean haylage (% DM) ¹.

Nutrient	Minimum	Maximum	Average
Crude Protein (CP)	14.5	22.9	19.3
Soluble Protein (% CP)	40.9	62.3	53.7
NDF	36.7	50.6	44.3
ADF	30.6	42.6	35.7
Lignin	6.9	11.5	9.4
IVDMD ²	61.1	77.1	69.3
NDFD ³	36.6	47.8	43.0
Oil	2.3	6.6	4.6
Ash	4.6	10.3	8.1
NFC	17.0	32.0	25.0
Calcium	0.67	1.39	1.01
Phosphorus	0.19	0.43	0.33
Magnesium	0.25	0.44	0.32
Potassium	1.37	2.48	1.85
Sulfur	0.12	0.24	0.18
Chloride	0.07	0.89	0.16
pH	3.48	5.10	4.67
Lactic Acid (%)	0.5	8.5	3.48
Acetic Acid (%)	0.8	6.1	3.06

¹Source: 20 samples from Analab, Inc., Fulton, IL; ²In vitro DM digestibility; ³Neutral detergent fiber digestibility.

Mustafa, A. F., J. C. F. Garcia, P. Seguin, and O. Marois-Mainguy. 2007. Chemical composition, ensiling characteristics and ruminal degradability of forage soybean cultivars. *Can. J. Anim. Sci.* 87:623-629.

Reid, J. 2001. Soybeans for silage? 2001. Cornell University Extension. <http://www.cce.cornell.edu/yates/AgCornell11.1.00.htm>.

Varga-Bello-Perez, E., A. F. Mustafa, and P. Seguin. 2008. Effects of feeding forage soybean silage on milk production, nutrient digestion, and ruminal fermentation of lactating dairy cows. *J. Dairy Sci.* 91:229-235.

for dairy cattle.

Soybean haylage can be ensiled very easily and a good silage inoculant is recommended to aid in the ensiling process. Lactic acid concentrations ranged from low to high, while pH values were very good to ensure long term storage. In addition, the concentrations of lactic and acetic acids, along with a low pH, ensure soybean haylage will be very stable during feed out in the feed bunk. Soybeans can be easily ensiled as a high quality forage for dairy cattle.

Given the ranges in quality that could be expected based on the maturity of the soybean haylage crop, a sample should be submitted to the laboratory for nutrient analyses and digestibility measurements. Soybean haylage has been fed by the author up to 35 lbs/cow/day on an "as fed" basis as part of a well-balanced ration. Vargas-Bello-Perez et al. (2008) reported similar energy corrected milk yields, feed efficiency, and nutrient digestibilities when early lactation cows were fed alfalfa silage or soybean silage.

Given the nutrient concentrations of soybean haylage as shown in Table 2, ration cost savings could be expected from feeding less of those ingredients containing CP, soluble protein (urea), fat, calcium, and phosphorus. Soybean haylage can be a great complimentary forage to corn silage and especially drought stressed corn silage.

References:

- Mustafa, A. F., J. C. F. Garcia, P. Seguin, and O. Marois-Mainguy. 2007. Chemical composition, ensiling characteristics and ruminal degradability of forage soybean cultivars. *Can. J. Anim. Sci.* 87:623-629.
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- Varga-Bello-Perez, E., A. F. Mustafa, and P. Seguin. 2008. Effects of feeding forage soybean silage on milk production, nutrient digestion, and ruminal fermentation of lactating dairy cows. *J. Dairy Sci.* 91:229-235.