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Sweet Clover Silage As a Feed For Dairy Cows

By

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Summary and Conclusions

The rapid growth of second-year sweet clover pasture in the spring and early summer compared with slower growth in late summer often causes the pasture to get ahead of the cattle. It is not uncommon to find a growth of 4 or 5 feet high that has little value as pasture or hay and is a problem to remove from the land. Making such overgrowth material into silage is suggested as a means of utilizing it as a feed for dairy cattle.

A feeding trial, using 8 dairy cows, showed that sweet clover silage was practically equal to corn silage, as measured by milk and butterfat production and body weights of the cows.

In the upper part of the silo the sweet clover silage was dark in color and had a characteristic coumarin odor. As the silage was fed off it improved in quality. The bottom half was light, greenish-yellow in color and had a clean, silage odor.

Sweet clover silage was not so palatable as corn silage, but the cows were soon accustomed to it and ate all that was offered but not so greedily as they did corn silage.

Good quality sweet clover silage does not taint milk and milk products any more than corn silage, but there is more danger of taints due to poor quality sweet clover silage than in the case of corn silage.

Sweet Clover Silage as a Feed for Dairy Cows

By

F. W. Atkeson and G. C. Anderson*

Sweet clover has increased very rapidly in popularity throughout the United States during the last decade. While formerly it was considered a weed pest it now is recognized as one of the best special pasture crops due to its heavy yields of forage and its ability to withstand drouth and other adverse conditions. Being a biennial legume, it fits into the crop rotation nicely and is a valuable soil improver. It has a wider adaptation than alfalfa and is being used to some extent as a hay crop.

In the northern part of Idaho sweet clover has become the leading pasture crop, and in the irrigated section it is becoming popular as a supplementary pasture crop. Although sweet clover continues to grow throughout the summer, even during periods of water shortage, in the late summer it blooms and attempts to form a seed crop, at which time its value as a pasture crop is greatly reduced. The difficulty of using sweet clover for pasture is largely one of management. In the spring the growth is very rapid, and it is difficult to keep the crop pastured down properly with the same size herd that the pasture will carry later in the season. Sometimes the growth of the second-year crop is 5 or 6 feet high, and the crop is no linger fit for pasture or hay. It is important to find some method of salvaging this large quantity of forage which otherwise is wasted and is a problem in preparing the land for the next crop.

The purpose of this experiment was to determine the feeding value of sweet clover silage for milk production. Although in some sections the tonnage per acre may warrant the consideration of this crop in preference to other crops, the thought the authors had in mind was primarily one of utilizing the overgrowth of sweet clover which would otherwise be wasted.

The results of this investigation are presented as a preliminary report, since no opportunity has presented itself for checking the work and as it seems advisable to report the data.

Review of Literature

Several writers (9, 14, 15, 22, 23) have suggested the possibility of utilizing sweet clover as a silage crop, particularly under special conditions. At the Missouri station (20) excellent quality silage was made from sweet clover and other legumes when the moisture content of the material ensiled was between 50 and 70 per cent. The Kansas station (2, 21) reported that sweet clover alone could be made into good silage with less difficulty than alfalfa. In comparing yields of white and yellow blossom sweet clover at different stages of growth Neidig and Snyder (14) reported that the white blossom variety "before blossoming" gave the heaviest yield.

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Considerable study has been devoted to the use of sweet clover as a silage crop in Canada. Derick (6) states that sweet clover silage is as good as alfalfa silage. He reports (7) that in two feeding trials with milk cows sweet clover was not quite equal to corn silage as measured by the body weights of the cows and the milk production. During the first year, some heifers on feeding experiment died with typical symptoms of sweet clover poisoning. Schalk (18) described this disease in detail and suggested methods of prevention and control. He reported the disease was due to long continued feeding of spoiled or damaged sweet clover hay or silage.

Shutt and Hamilton (19) described and reported analyses of four samples of sweet clover silage sent in to the Division of Chemistry of the Dominion Department of Agriculture. Hopper (13) states that sweet clover is comparatively easy to ensile. He suggests cutting with a binder and allowing the bundles to wilt 2 or 3 hours in the field. Until cattle become accustomed to sweet clover silage they do not eat it as readily as other silage.

The Ontario Agricultural College (1) cut 5 acres of sweet clover with a binder when the crop was in the late bud stage and about 4 feet high. The yield slightly exceeded 7 tons per acre. Excellent silage resulted, and a feeding trial conducted with seven cows showed that slightly better production was obtained when 22.8 pounds of sweet clover silage were fed in addition to other feeds than when 35.8 pounds of corn silage were fed. Some farmers reported that sweet clover silage had a slightly constipating effect on the cattle. From experiments in making silage at various stages of maturity of the plant, they concluded that the best time to cut the crop for silage was when the plants are "just commencing to bud" or "the late bud stage." The flavor of milk was not affected when sweet clover silage was fed unless the milk was unnecessarily exposed to the silage odor in the barn.

Hopkins (12) reported a yield of 7.9 tons of sweet clover silage compared with 13.5 tons for corn, and 6.79 tons for oats, peas, and vetch silage.

At the North Dakota station, Dice (8) fed to dairy cows sweet clover silage made by stacking green sweet clover. The silage was excellent but not so palatable as corn silage. A feeding trial showed milk production to be only slightly in favor of corn silage, but about 10 per cent more sweet clover silage was wasted. Flavor of the milk was not affected. Miller and Christensen (16) of the same station state they believe sweet clover silage fed to dairy cows over long periods would give better results than have been reported through short period comparisons with corn silage due to the palatibility of the two silages affecting consumption when changes are made. In feeding steers, Christensen (3, 4) obtained smaller daily gains with sweet clover silage than with corn silage, and found the corn silage contained 10 per cent more total digestible nutrients than the sweet clover silage, which he attributes to the grain in the corn silage.

Gamble and Kelly (11) tested the flavors and odors of milk when 5, 10, and 15 pounds of sweet clover silage were fed both before and after milking. They concluded that sweet clover silage tainted the milk even when

fed after milking but that if the milk was aerated while still warm as much as 15 pounds of this silage could be fed after milking without seriously tainting the milk.

Feeding Trial

The plan consisted of a comparison of sweet clover silage with corn silage as a succulent feed for dairy cows with other conditions as nearly standardized as possible. Eight purebred Holstein cows were selected from the University of Idaho herd for use in the experiment. The cows were divided into two groups of four cows each. An effort was made to balance the groups with respect to weight, age, production, and period of lactation and gestation.

The experiment covered a period of 80 days, divided into three experimental periods of 20 days each and three preliminary periods consisting of 10 days for the first and 5 days each for the second and third. The second and third preliminary periods were shortened after the experiment was in progress due to shortage in the amount of sweet clover silage.

The double reversal system of feeding was used. Cows in Group I were fed corn silage during the first and third periods and sweet clover silage the second period. Simultaneously, cows in Group II were fed sweet clover silage during the first and third periods and corn silage the second period. The milk from each cow was weighed every milking and tested for butterfat the middle two days of each 10 days of the 20-day experimental periods. The cows were weighed individually three consecutive days previous to each preliminary and experimental period, and the last three days of the final period. The average of the three weights in each case was taken as the true weight. All feed was weighed to the cows individually and the refused feed weighed back. A composite sample of all feeds offered and all feeds refused was taken for chemical analysis.

During the first preliminary period an attempt was made to determine the amount of hay and silage each cow readily would consume daily in addition to the grain ration. The estimates thus obtained were used in standardizing the hay and silage, regardless of kind, throughout all experimental periods, thereby making as nearly as possible the amount of hay fed constant for each cow and the comparisons of the two silage crops direct pound for pound. The grain was fed at the rate of one pound to each three pounds of milk produced per day. The amount of grain to be fed each cow was determined by averaging the daily milk production for each five days and feeding the proportionate amout of grain the next five days. The grain mixture used was the standard herd ration which was as follows:

350 lbs. wheat bran
200 lbs. barley (ground)
200 lbs. oats (ground)
100 lbs. linseed meal
100 lbs. cottonseed meal
36 lbs. mineral mixture

The analysis of the feeds used as represented by composite samples is given in Table I.

The corn silage analysis compares fairly closely to the average of 121 analyses of well-matured corn silage reported by Henry and Morrison (1), while the sweet clover silage is comparable in composition to the alfalfa silage (high in moisture) reported by the same authorities. Table I shows the sweet clover silage was higher in moisture and lower in dry matter than the corn silage. The most striking differences were that the sweet clover silage contained about one-third more protein and about one-half as much nitrogen-free-extract as the corn silage, making the nutritive ratio of the sweet clover silage considerably narrower than that of the corn silage. The sweet clover silage contained much more crude fiber than the corn silage.

Description of Feeds

The alfalfa hay used was first-cutting alfalfa grown near Moscow, Idaho. The corn for silage was grown on the University farm and was typical of that grown in this region.

The sweet clover silage was made from a second-year stand of white sweet clover. The field contained about 15 acres, and 15 cows had been pastured on the sweet clover since it was first ready in the spring. In addition, four horses were pastured a short time. The number of stock was insufficient to keep the sweet clover down to the best height for pasture purposes. At the time of cutting for silage the crop averaged about 5 feet in height, varying from 4 to 6 feet, depending on soil and other conditions. The stand was not uniform since the field had not been properly prepared for seeding.

Harvesting began on July 25 when the crop was in full bloom. No attempt was made to cut the clover at the ideal time for silage purposes as the crop was purchased as an emergency silage crop. Most of the crop was harvested with a binder, but due to delays in filling, the clover became so dry and the binder choked so badly that it was necessary to cut the remainder with a mowing machine. Most of the crop was left on the ground only a few hours before hauling to the silage cutter. The silo filling process was the same as practiced for corn except more care was exercised in keeping the knives of the cutter sharp.

The crop was weighted into the cutter, but the exact yield per acre was not obtained since only part of the field was used. The owner of the field estimated about eight acres were cut. Since 64 tons were ensiled this would make an estimate of about eight tons of silage per acre. Even should this estimate be high the yield must be considered very good, inasmuch as the stand was was not uniform and the crop had been pastured continuously since spring.

When the silage was first opened it was dark colored, almost black, and had a strong odor with the coumarin odor quite pronounced. The cows did not relish it and much was wasted. The silage got better deeper down in the silo. The last third was bright in color, did not have the strong coumarin odor, had a typical silage fermentation odor, and was relished by the cows. There was considerable waste during the first two periods of the experiment, however, and the best silage was used only during the last per-

iod of the experiment. The poorer quality of the upper half may have been due to the dryer and more mature stage of the plant, lack of pressure for thorough packing, lack of fineness in cutting, or a combination of these causes.

Results

A summary of the results of the feeding trial is presented in Table II. The average of the first and third periods was compared with the second period in all instances to offset decline in milk production and control other factors as the experiment progressed. The fact that the average butterfat production of both groups was nearly a pound per day would indicate that the production was sufficiently high to reflect significant differences in the two rations.

The results from the two rations were as nearly identical as it would seem possible to obtain. Daily feed consumption for both groups combined was 23.4 pounds of silage, 15.0 of alfalfa hay, and 9.7 of grain mixture while being fed corn silage; and 23.4 pounds of silage, 15.6 of hay, and 9.6 of grain mixture while being fed sweet clover silage. Daily production of 4 per cent milk ("fat-corrected basis" [10]) was slightly higher in Group I and slightly lower in Group II while the cows were receiving corn silage than when sweet clover silage was fed. When the two groups were averaged together the daily milk production (fat-corrected) was 25.6 when corn silage was fed and 25.1 when sweet clover was fed. This is as similar as could be expected. Milk is fat-corrected to a 4 per cent basis by multiplying the pounds of milk by 0.4 and adding this result to the pounds of fat multiplied by 15. The object of adjusting milk production to a fat-corrected basis is to combine into one figure the energy output in milk and fat production.

The average weight of the cows in Groups I and II at the beginning of the corn silage test period was practically the same as the corresponding weight for the cows on sweet clover silage. The average gains of 7and 6 pounds while on the two rations may be considered as practically no change since more variation than that is obtained in consecutive days' weights (5).

Summarization of the two groups combined showed that when corn silage was fed the cows consumed daily 3.04 pounds of digestible crude protein and 18.06 pounds of total digestible nutrients; and when sweet clover silage was fed, the daily consumption was 3.15 pounds of digestible crude protein and 16.64 pounds of total digestible nutrients. About 8 per cent less total digestible nutrients and 3.6 per cent more protein were consumed daily on the sweet clover silage ration. These differences were due to the higher protein and lower carbohydrate equivalent content of the sweet clover silage compared with corn silage. For the same reason the nutrients consumed per 100 pounds of 4 per cent milk showed more digestible crude protein and less total digestible nutrients used on the sweet clover silage ration (12.73 and 65.82 respectively) than with the corn silage ration (11.97 and 71.12).

Considering comparisons of milk and fat production, body weight increases, and nutrient intake, the results obtained with sweet clover silage seemed practically identical to those obtained with corn silage.

Palatibility

The sweet clover silage varied greatly in apparent quality from top to bottom of the silo. The top part was very dark colored and had an offensive odor with the coumarin odor rather pronounced. The bottom part of the silage was a bright, greenish-yellow color and had a characteristic clean, silage odor. The feed weights indicate that while on the experiment the cows consumed about the same amount of sweet clover silage as corn silage with very little weigh-back. They ate the dark-colored, strong-odored silage much less greedily, however, and considerably more difficulty was experienced in getting the cows "on feed" during the preliminary periods. It would seem from observation that the good quality sweet clover silage in the bottom part of the silo was almost as palatable as the corn silage, but the dark-colored sweet clover silage was less palatable.

Effect of Sweet Clover Silage on the Flavor and Odor of Milk and Milk Products*

A group of four Holstein cows was fed eight pounds of sweet clover silage just before milking for a week and then the silage was fed just after milking for a week. Another group of four Holstein cows was similarly fed corn silage. After the cows had been under each system of feeding for several days the milk of each cow and the composite milk of the group was scored for flavor and odor. The cream from the milk was likewise scored, as was also the butter made from the cream. The sweet clover silage used was bright yellowish-green in color and had a characteristic silage fermentation odor.

When the silage was fed before milking a silage flavor and odor was found in the warm milk, the off-flavor being more pronounced in milk from the cows fed corn silage than in the milk from cows fed sweet clover silage. After the milk was cooled and aerated the silage flavor and odor was not noticeable. None of the milk from cows eating sweet clover silage had any off-flavor or odor which might be considered as being peculiar to sweet clover silage, such as coumarin flavor. In the case of both silages the cream and butter had no silage or feed flavors.

Even when the silages were fed after milking, silage flavors and odors were found in the warm milk, although they were possibly not quite so noticeable as when the silages were fed before milking. The fact that about the same amount of taint was present in the milk produced from both silages, and when the silages were fed both before and after milking would indicate that the off-flavors and odors may have been absorbed from the barn air. The results justify the conclusion that good quality sweet clover silage is no worse than corn silage in causing taints in milk and milk products. This conclusion is in agreement with the reports from the Ontario Agricultural college (1) and Dice (8) of the North Dakota station, but is contrary to the report of Gamble and Kelly (11).

It seems worthwhile to call attention to the great difference that may exist in the quality of sweet clover silage. In fact, that is true of most leguminous silages. It has been previously mentioned that about the up-

*The authors are indebted to H. A. Bendixen, formerly Assistant Dairy Husbandman, Idaho Agricultural Experiment Station, for scoring and processing the milk and milk products.

per third of the sweet clover silage used in this experiment was dark colored, almost black, and had a strong odor with the coumarin odor quite pronounced. The silage got better deeper down in the silo. The silage used for the flavor and odor studies came from close to the bottom of the silo. Such difference in the quality of the silage in the same silo would indicate that different results might be obtained on studies of flavors and odors of milk if the silages used differed in quality, particularly if the sweet clover silage was made in a small experimental silo.

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TABLE I
Chemical Analyses of Feeds
(In Percent)

FEED	Water	Ash	Crude Protein	Carbohydrates		Fat
				Fiber	N.F.E.	
Grain	8.10	6.39	18.65	10.46	51.35	5.05
Alfalfa Hay	6.17	7.42	12.65	36.25	35.84	1.67
Corn Silage	70.9	2.59	2.03	7.03	16.35	1.10
Sweet Clover Silage	76.0	1.96	2.98	9.41	8.0	1.65

NOTE: Determinations made by the Department of Agricultural Chemistry, Idaho Agricultural Experiment Station.

TABLE II

Results of a Feeding Trial Comparing Sweet Clover Silage with Corn Silage

	Group I		Group II		Ave. Both Groups	
	While on corn silage	While on sweet clover silage	While on corn silage	While on sweet clover silage	While on corn silage	While on sweet clover silage
Period	I & III ave.	II	II	I & III ave.		
Number of cows used	4	4	4	4	8	8
Ave. lbs. of silage consumed daily per cow	22.7	23.7	24.0	23.0	23.4	23.4
Ave. lbs. alfalfa hay consumed daily per cow	15.4	15.5	14.6	15.6	15.0	15.6
Ave. lbs. of grain mixture consumed daily per cow	10.8	10.6	8.6	8.5	9.7	9.6
Ave. lbs. of milk produced daily per cow	32.2	30.2	25.0	24.9	28.6	27.6
Ave. lbs. of butterfat produced daily per cow	1.05	1.00	.84	.88	.95	.94
Ave. percentage of fat in milk	3.26	3.31	3.36	3.53	3.32	3.41
Ave. lbs. of 4 percent milk produced daily per cow	28.6	27.1	22.6	23.0	25.6	25.1
Ave. body weight per cow at beginning (lbs.)	1262	1269	1344	1333	1303	1301
Ave. gain per cow in body weight per 20-day period	+25	−2	−12	+14	+7	+6
Ave. lbs. digestible crude protein consumed daily per cow*	3.24	3.34	2.85	3.02	3.04	3.15
Ave. lbs. total digestible nutrients consumed daily per cow*	18.84	16.29	17.26	16.45	18.06	16.64
Ave. lbs. digestible crude protein consumed per 100 lbs. 4 per cent milk	11.33	12.32	12.61	13.13	11.97	12.73
Ave. lbs. total digestible nutrients consumed per 100 lbs. 4 per cent milk	65.87	60.11	76.37	71.52	71.12	65.82

*Computed from chemical analyses in Table I and digestion coefficients in "Feeds and Feeding" by Henry and Morrison. Digestion coefficient for clover silage used for sweet clover silage.