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Acceptability of High-Drymatter SILAGES

CHARLES F. ROGERS

D. S. BELL

OHIO AGRICULTURAL
EXPERIMENT STATION
Wooster, Ohio

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ACCEPTABILITY OF HIGH-DRYMATTER SILAGES

CHARLES F. ROGERS and D. S. BELL

Ensiling meadow crops is a sure, flexible and reasonably economical means for saving the spring growth. Grass silages can provide the base ration for livestock when pasture is inadequate or unavailable. To meet emergencies, ensiling of forages in danger of weather damage, or already damaged, is a good practice, but only a secondary reason for making silage. Good forages, properly ensiled at the right stage of growth, will remain excellent feeds for an indefinite period. Feeding qualities of such silages can closely approach the feeding qualities of the original crops though their appearance and flavor will be much different.

Legumes, grasses or their mixtures will make good silages without added conditioners. When conditioners are not to be used, some wilting is desirable to raise the drymatter in standing crops ready for silage or hay. Untreated silages are generally acceptable if the drymatter is more than 30 percent. If crops are young when ensiled, wilting up to 40 percent drymatter tends to improve palatability, and the silages are reasonably easy to make. Meadow crops in best condition and stage of growth for hay can make good silages whether wilted or not.

Control of wilting to reach the 30-to-40-percent-drymatter content, has been and remains an unsolved problem in both the experimental and the practical ensiling of meadow crops. Firm belief in the necessity of ensiling wilted crops in this range, and the present difficulty of knowing when wilting crops come into this range, is so discouraging to some persons that they do not attempt to ensile meadow crops. The common alternative usually chosen is the ensiling of unwilted crops with consequent juice loss.

If information were available on how to process crops at various stages of growth and degrees of wilting, even those well along toward the dryness of hay, there would be less real need to try to control the wilting before taking the crops into the silo. Sometimes by necessity or accident, crops will be much wilted before it is possible to put them into

the silo. Past experiences have shown that the degree of wilting is likely to be less of a factor in keeping qualities of the silage than is the stage of growth when wilting began.

SILAGES FROM WILTED CROPS FOUND GOOD

Shepherd, et al. (1) ensiled alfalfa at 40 percent drymatter. In comparison with "barn- and field-cured" alfalfa from the same stand, they fed dairy cows the 40-percent-drymatter silage to study milk yields and changes in body weight. Based on drymatter intake, productivity and animal condition at the end of a 40-day feeding period, the wilted alfalfa silage was slightly more palatable than either barn- or field-cured hay from the same alfalfa. It sustained milk production and body weight better than did the hay.

Schulz (2) reported that several farmers have "sun-cured" alfalfa before ensiling. They let their alfalfa lie in the sunshine of northwestern Washington for a day or two before putting it into large silos and covering with peavines. Cows ate up to 100 pounds of the silages daily with good milk production and satisfactory maintenance of body weight when fed a minimum of concentrates.

Some of the commonly stated drawbacks of high-drymatter silages are:

1. **low tonnage of materials in the silo**
2. **apparently low palatability of the silages as measured in pounds against ordinary silages**
3. **lack of color in such "dry silages" and the presumed or real lack of pigments associated with green color, (β-carotene especially)**
4. **lack of distinctive flavors**
5. **tendencies of some wilted silages to heat in the silo ahead of use as discussed by Rogers** (3)

These are some of the reasons for Perkins' (4) designation, on his drymatter scale, of the range between 40 and 60 percent drymatter as "no man's land". In this region he noted the possibility of making good silages, but pointed out the difficulties. Woodward, et al. (5) who worked in the lower part of this range, report success with 40-percent drymatter material.

Hayden, et al. (6) made silages ranging from 17 to 35 percent drymatter. In general their data show that, up to the top limit of their studies, the qualities of the silages rise with increase in drymatter. Crops used and treatment also had their effects, but in line with the moisture-drymatter relations.

REASONS FOR MAKING HIGH-DRYMATTER SILAGES

The possibility of making good high-drymatter silages, being well known, the experimental silages involved here were made to learn how high the drymatter could go, and still have acceptable silages when fed in limited quantities. Large scale tests would have to await favorable combinations of availability of wilted crops and animals to eat the resulting silages.

With the purpose of learning how to make silages at drymatter levels above the ranges indicated by the workers cited, four groups of high-drymatter silages were made, using the crop available under varying conditions.

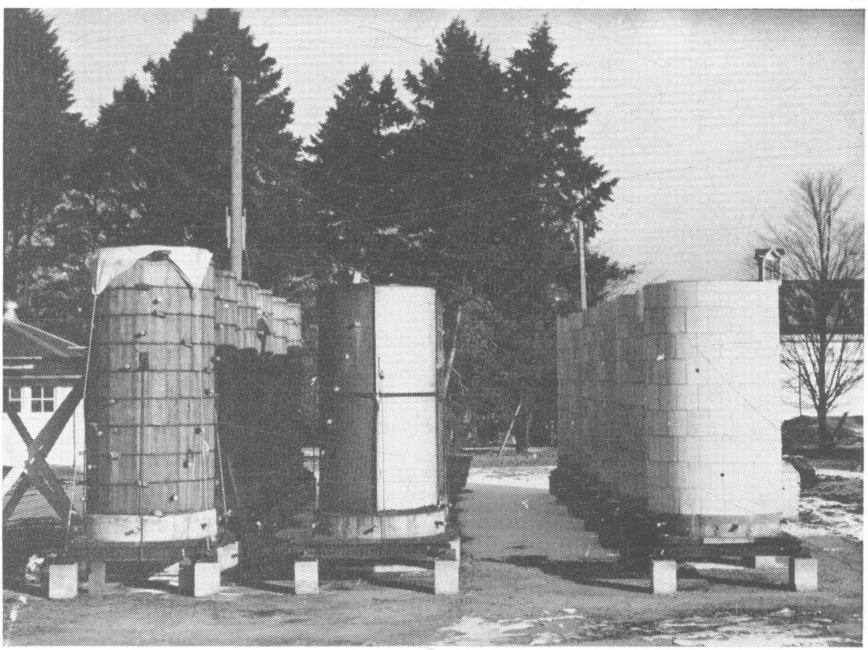

Fig. 1.—These 78-cubic-foot Pilot Silos were used in making three of the four groups of silages reported in this work.

FACILITIES USED

Three of the four groups of high-drymatter silages were made in the 78-cubic-foot Pilot Silos in the Silo Building at the Ohio Experiment Station, using crops obtained from aftermath in late summer, or from other material notably high in drymatter and without high quality when ensiled.

The high-drymatter silage of the fourth test was from crops of good quality, cut at best stage, wilted suitably, and put into a Sheep Farm silo near the top of the filling, but adequately covered by crops and Silage Cap as described by Rogers (8).

The silages standard for sheep feeding and for test comparisons of the experimental silages were made in the twin 50-ton tower silos or the 30-ton trench, at the Sheep Farm. These silos are regularly filled in early June with fresh spring growth to which has been added at the blower an estimated 150 pounds of ground earcorn per ton of green crop.

Sheep were the test animals throughout these feedings of experimental silages against the standard silages of 1946, 1948, and 1949.

CROPS AND TREATMENT

The 1946 silages. Table 1 shows the drymatter of the crops and resulting silages, and the crop mixtures for the 1946 silages. The five 1946 silages (A-E) in Table 1 were from an aftermath of sparse

TABLE 1.—Crop Composition and Drymatter Content in Silages

Silages		Drymatter in Crop	Drymatter in Silage	Crop Mixture and Condition
		%	%	
High-drymatter	A	64.4	60.5	85 percent timothy, 12 percent legume, 3 percent weeds; seeds mature, but most leaves green, much too ripe for best silage making, wilted in windrow, ensiled in Pilot Silos, August to September, 1946.
	B	63.3	64.1	
	C	59.9	56.4	
	D	63.3	68.2	
Low-drymatter	E	35.2	37.2	32 percent timothy, 49 percent legumes, 19 percent weeds; late blooming stage, second growth ensiled without wilting in Pilot Silos, August, 1946.
Standard	F	24.5	30.0	High in timothy; alfalfa and other legumes in full bloom, chopped from standing, treated immediately with 150 pounds ground earcorn, June, 1946. Sheep Farm Silos.
	G	24.5	28.0	

timothy and alfalfa harvested in late August and September, 1946. Wilting during mowing, raking and hauling brought 4 of the 5 lots to well above the 40-percent "safe drymatter limit" suggested by Perkins (4). The forage was chopped and packed into the Pilot Silos. By the time of use, four to five months later, some of the experimental silages showed a slight rise and others a slight decline in drymatter as compared to the original condition. Silages F and G were standard silages made at the Sheep Farm in June 1946. The rise in the drymatter of these silages is from the addition of the estimated 150 pounds of ground earcorn per ton of green crop.

The 1947 silages. In late June 1947, wilted and unwilted crops in advanced stages of growth went into Pilot Silos for tests of silage surface sealing. The unwilted alfalfa-timothy mixture was well past full bloom. The other crop was predominantly bluegrass at ripe seed stage, mixed with other hollow-stemmed grasses and some weeds.

The alfalfa-timothy mixture was moderately moist when ensiled. It came out a moist silage. The bluegrass mixture was noticeably dry from wilting and age. It was fluffy when packed in the silos and remained a rather spongy silage. These silages, held in the Pilot Silos until mid-June 1948 to permit the completion of the silage sealing experiments (8), were offered to sheep at a time unsatisfactory for palatability tests.

The 1948 silages. The plan for the 1948 Pilot Silo filling called for young crops, rich in legumes, not older than early bloom, but much wilted and preferably wilted without being rain damaged. The crops were to be in condition equivalent to those that went into silos at Sheep Farm the same season, the only difference being the percentage of drymatter at the time of ensiling.

The crop material made available for this experiment in 1948 was mostly grass, some legume and many weeds, especially dock; all were in advanced stages of flowering or seed formation, had been in the swath from 48 to 72 hours and had suffered two heavy showers after initial wilting. There was no green color remaining. The quality of the wilted crop as ensiled was far below that suitable for the projected tests. It went into the Pilot Silos without chance for preliminary heating, and it did not heat in the silos.

Drymatter varied widely, from one silo to another as shown from data on resulting silages in Tables 4 and 5. In addition to the test of the making of high-drymatter silage, this year's ensiling served to show how good the silages could be, even when starting with inferior material.

The 1949 silages. Late in the afternoon of June 1, 1949, a young meadow crop, predominantly timothy, with alfalfa and clover, was mowed and left in the swath. It was windrowed the next day, and just before sundown on June 2 was put into the east tower silo at the Sheep Farm. The wilted crop received no treatment. It was covered immediately with a Silage Cap, which remained until this wilted crop was covered June 3 to about 6 feet of depth with fresh unwilted crop treated with ground earcorn.

On June 3, before covering the wilted silage with moist crops, the unwilted crops from the same part of the field as those wilted on June 2 went into the west silo at the Sheep Farm near the top at the same level as the wilted crops in the east silo. The unwilted crops received the estimated 150 pounds of ground earcorn per ton of crop standard for silage at the Sheep Farm.

Both silos were topfilled to the same depth, topfills treated with sulfur dioxide and each covered with a Silage Cap. This chemical treatment extended down less than 18 inches under the caps, hence had no effect on the condition of either experimental silage. The Silage Caps and the sulfur dioxide limited spoilage to a small amount next to the doors.

The silages were left in place until December 1949.

SILAGES AND FEEDING TESTS

The 1946 silages. Different amounts of silages were obtained from Pilot Silos, because of spoilage variations, and the fluctuation in density of silages with moisture:drymatter ratios. Scorings at times of feeding these silages, indicate that the silages were not markedly different. Blandness of flavor seemed to be a reason for low scoring.

Three pens of sheep were used to test acceptability of these high-drymatter silages. Pens 1, 2, and 3 contained respectively, 46 Columbia ewes, 77 Merino ewes, and 66 Shropshire ewes. These feeding trials lasted 20 days, during which time each of the sheep received the ration:

Mixed corn and oats	0.50	pounds	
Soybean meal	0.10	pounds	
Legume-grass silage F or G	1.50	pounds	the evening feed
Silage A, B, C, D or E	1.50	pounds	the evening feed
Mixed hay, rich in clover	1.5	pounds	to Merino and Shropshire, the morning feed
	2.0	pounds	to Columbia, the morning feed

This means that for the test feedings, each pen of sheep was offered, each evening, half its regular 3-pound silage allowance as high-drymatter experimental silage. The other half was the regular silage to which the sheep were accustomed. The silages A to E were fed successively in racks separate from silages F or G.

The feeding of Silages A to E was in the evening, at the rate of 282 pounds per day, which constitutes half the silage ration. Simultaneous feeding of Silages F and G was at same rate as the experimental silages. The only difference between Silages F and G was the drymatter content. Each kind of Silage A to E was fed out before the next kind was opened.

Invariably the sheep preferred the silage to which they were accustomed (Silages F or G), and ate it before they began on the experimental silage offered that day. By the next feeding time, however, when any uneaten silage was removed and weighed before the hay was put into the racks, the Columbia and the Merino ewes had eaten all the high-drymatter experimental silage offered them each time. The Shropshire ewes left a few pounds of the experimental silages at each feeding, probably because they were slightly over-fed on silage. The amount of silage refused varied from 9 to 16 percent of the total amount offered. The fresh and dry weights of the experimental silages refused by the Shropshires were:

Silage A	46 pounds as fed	27.8 lb. dry
Silage B	50 pounds as fed	32.1 lb. dry
Silage C	43 pounds as fed	24.3 lb. dry
Silage D	27 pounds as fed	18.4 lb. dry
Silage E	64 pounds as fed	23.8 lb. dry

The weight of silages left by the Shropshires is shown at the bases of the column for experimental silages in Figure 2.

This offering of drier silages increased the intake of drymatter in the silage fed each time, as much as 66 percent. Because the amount of each experimental silage available was small, there was no opportunity to learn how well the intake of extra drymatter would be sustained over long periods of feeding. There was no appreciable decrease in the amounts of hay consumed when the experimental silages were fed.

Either from habit, or because of greater palatability of the corn-treated grass silages F and G, the sheep preferred them, but the high-drymatter silages in each case were reasonably acceptable on the "as fed" basis to all three breeds.

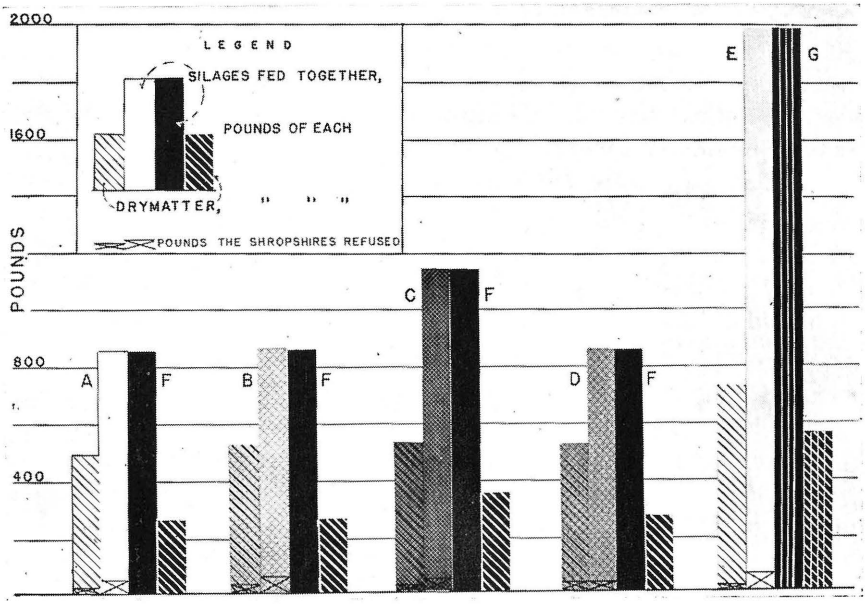

Fig. 2.—The tall columns show weights of silages fed. The short ones show pounds of drymatter; they also illustrate the "A/F . . . . E/G" relations of Table 3.

The shaded columns in Figure 2 show the total amounts of drymatter in each combination of silages. Table 3 gives dryweights eaten. In lines "A/F, B/F, ..." the ratios of drymatter in each experimental silage to that in the standard silage used for comparison show how much more the experimental silages provided. Silage D, being highest in drymatter, showed the highest ratio of drymatter intake in experimental silage to the standard.

These feedings of experimental silages and their acceptance by sheep confirmed the Scoring Committee's judgment that all silages were "fair" to "good" in quality (Table 2).

The only surprise in the "fair" to "good" scorings of the Silages A to E is the relatively high human estimate of them. The forage crops ensiled were not of the best quality, being both too old and mixed with too much litter from previous cuttings. Younger crops wilted to the same drymatter content might have been much greener under the same conditions, because the green portions of the ensiled crops (Silages A to D) retained much of their original color. Like all other silages, these experimental high-drymatter silages were no better than the forages from which they were made.

The 1947 silages. These silages were not available for test feeding until about 6 weeks after the sheep had gone on pasture.

For at least a week, sheep in the barn after being on pasture all day had access each night to both standard silages and those from the Pilot Silos. Comparisons were not possible because the sheep showed little or no interest in any silage at this time.

The 1948 silages. Columbia, Merino and Shropshire ewes in 8 different lots received silage during the period April 15 to May 3, 1949. These sheep ate all the silages offered, until the last day, May 3, when they went on pasture. The established feeding rate of standard silage and the drymatter content of this weight of silage was the basis for experimental feeding. Eight lots of sheep received enough of the 1948 experimental silages to provide each day, one-half the dry weight of the whole silage ration. Standard silage provided the other half.

Fresh weights of the experimental silage feedings varied inversely as the drymatter content of the silages. In Table 4 are the drymatter percentages of the silages made in the Pilot Silos, and the total dry weight fed from each. Table 5 shows the daily half-ration of standard silage, its drymatter content in pounds, total feeding days in each pen, the total fresh weights of the standard and experimental silages, and the

TABLE 2.—Descriptions and Scoring of 1946 Silages Fed to Sheep

Silages	Percent Drymatter	Numerical Score	Average Scorings*	
			Rating	Description
A	60.5	72	fair,	all ratings low
B	64.1	75	fair,	color and taste low
C	56.4	79	good,	color and taste fair
D	68.2	70	fair,	color and taste low
E	37.3	79	good,	color and taste good, odor least satisfactory
F	30.0	86	good,	physical condition low, odor and taste best
G	28.0	82	good,	physical condition lower than F, color good, odor a little leathery

*Scoring was done mostly in the Department of Dairy Science. Scoring data were supplied largely by C. C. Hayden, Chairman of the Scoring Committee for the Silage Project. Silages A, B, C, D, E were made in cooperation with W. A. Junnila, then a member of the Department of Agricultural Engineering.

TABLE 3.—Weights of Drymatter in the 1946 Silages Eaten

Kinds of Silages	Feedings	Sheep					
		Columbia		Merino		Shropshire	
		lb.	lb.	lb.	lb.	lb.	lb.
A	3	125.2		206.9		151.9	
F			62.1		102.6		89.1
*A/F		2.02		2.02		1.70	
B	3	132.7		219.2		158.3	
F			62.1		102.6		89.1
*B/F		2.14		2.14		1.78	
C	4	155.7		257.2		199.0	
F			82.8		136.8		118.8
*C/F		1.88		1.88		1.68	
D	3	141.2		233.2		184.2	
F			62.1		102.6		89.1
*D/F		2.27		2.27		2.07	
E	7	180.5		297.7		234.7	
G			135.5		223.4		234.7
*E/G		1.33		1.33		1.21	

*The row "A/F" and the corresponding rows for silages B, C. D, E show the number of pounds of drymatter in the experimental silages **eaten,** for each pound of drymatter in the standard Sheep Farm silages eaten over the same period by each breed of sheep. The Shropshires did not eat all the experimental silages; the amounts of refused silage appear in the text.

total dry weight in each half-ration of either silage. The pounds of silage eaten by the sheep were fewer than in the feeding test of 1946 silage.

Considering the condition and qualities of these much wilted 1948 crops, the acceptability to sheep of the resulting silages was better than expected at the time of ensiling.

For some reason there was no heating in these silages when left exposed in the silo, in spite of the uniformly warm spring weather. From experience elsewhere with silages of this kind, heating would have taken place in the short time that they were exposed. The heating did not occur in the 1946, 1947, or 1948 high drymatter silages.

TABLE 4.—1948 Silages Fed from Pilot Silos, the Percentages of Drymatter and Pounds of Dry Weight

Pilot Silo	Pounds Fed	Drymatter in Silage	
		Percent	Pounds
T-II	423.2	86.6	366.5
T-III	733.1	77.5	568.2
T-IV	1463.4	37.8	553.2
T-V	884.4	62.2	550.1
T-VI	887.4	60.6	537.8
S-V	102.0	71.1	72.5
S-VI	963.2	49.2	473.9
Totals	5456.7		3122.2

No one should plan to make silages from inferior crop materials. Ensiling does assist in saving and utilizing crops of low quality, whether the low quality be from the presence of weeds, age of the crop or weathering in the field after mowing. Even though animals may eat the silages, it does not follow that silages of this kind should be used as a base roughage. When other crops are available for ensiling, it is a mistake to use silo capacity to process crops of poor quality. The time and labor of placing such crop material in horizontal silos is likely to be wasted because of the common tendency of silage from crops in this condition to spoil during use. Opposed to this extreme, Schulz (2) has reported on the successful use of silage from wilted crops of good quality as the basic roughage feed for dairy cattle.

The 1949 silages. There was a break in the feeding of the 1949 high-drymatter silage. At first, the experimental silage from east tower silo at the Sheep Farm was compared with silage from similar crops put into the trench silo. Then several weeks later it was fed against the identical crop ensiled in the originally fresh condition in the west tower silo.

Before December 2, 1949, the 459 sheep were getting daily an average of a little less than 3 pounds of silage at 26.5 percent drymatter from the trench silo and from topfill of the east silo, above the high-drymatter silage. From December 2 to December 10, they received the same weight of silages, half from the trench and half from the high-drymatter experimental silage (Table 6).

As in all the previous experiences, the sheep ate first the standard silage that was stronger in flavor, but by the next morning had cleaned up all of the high-drymatter silage.

TABLE 5.—The Feeding of the 1949 Standard and High-Drymatter Silages to Sheep

Sheep		Half-ration standard silages		Total feeding days	Total fresh weight each half-ration		Total drymatter in each half-ration
Kind	No.	Fresh	Drymatter		Standard	"Dry"	
		lb.	lb.		lb.	lb.	lb.
Shropshire yearling ewes	13	13	3.1	247	247	104.8	58.9
Merino yearling ewes	22	22	5.3	418	418	178.7	100.7
Columbia yearling ewes	20	20	4.8	380	380	160.1	91.2
Shorpshire brood ewes	59	103.3	24.8	1121	1962.7	812.1	471.2
Merino brood ewes	65	113.8	27.3	1235	2162.2	896.0	518.7
Columbia brood ewes	49	110.3	26.5	931	2095.7	872.6	503.5
Columbia × Merino ewes	84	189.1	45.5	1596	3592.9	1512.6	864.5
Merino ewes	60	112.5	27.0	1140	2137.5	919.8	513.0
Totals	372	684	154.3	7068	12996.0	5456.7	3121.7

In the 12149 pounds of moist silage fed, there were 3460.5 lb. of drymatter, whereas the same weight of "dry" silage contained 6609.0 pounds of drymatter. This is 1.91 times as much. During the test feeding the drymatter intake from silage was 1.45 times that given in the standard silage before and after.

The 16-day delay between the comparative feeding from the trench and that from identical forage ensiled to be the standard silage, was the time needed to finish feeding from the trench, and to open the "west" silo and feed down to the silage made for the feeding trials. A Silage Cap protected the surface during the time the high-drymatter silage was not in use. Even at the wall and door there was no tendency to mold. In other silos in Ohio, material older and much moister when ensiled, tended to spoil ahead of use in the silo once it was opened.

TABLE 6.—Pounds of Silages from the Much-wilted and the Unwilted Identical 1949 Crops, Fed Simultaneously to Sheep

Sheep farm silo	Number of sheep fed	Sheep feeding days	Pounds of Silage Fed to All Sheep			
			Daily		Total all days	
			fresh	drymatter	fresh	drymatter
		From December 2, to December 5, 1949				
Trench	459	1836	666	176.5*	2664	706.0*
East			666	362.3‡	2664	1449.2‡
		From December 6, to December 10, 1949				
Trench	458§	2290	664.5	176.1*	3322.5	880.5*
East			664.5	361.5‡	3322.5	1807.4‡
		From December 26, 1949 to January 3, 1950				
West	457	4113	662.5	226.9†	6162.5	1874.0†
East			662.5	360.4‡	6162.5	3352.4‡
Totals	459-457	8239	In each half-ration—12149			
			drymatter in moist silage			3460.5
			drymatter in much-wilted silage			6609.0

*at 26.5 percent drymatter in trench silage.
†at 34.1 percent drymatter in "West" silage.
‡at 54.4 percent drymatter in "East" silage.
§one sheep died December 5, 1949.

It is important to note that the young green crops lost in the field 61.8 percent of the fresh-crop weight, and retained only 22.0 percent of the original moisture. This amount was still enough to keep the crop moist, soft enough for compaction, and to produce a bland, but in no way caramelized flavor. The silage even in the warm winter weather of December 1949, showed no tendency to spoil ahead of use when as little as a third of a ton (a 4-inch layer) of silage was removed daily. Considering the short time of the experiment, the preference shown by sheep for the sharp flavored silages over the bland, is not surprising.

The qualities of the 1949 silages from wilted and unwilted crops were comparable in this series of tests, because the initial crops were alike. It seemed proper therefore to obtain, along with the drymatter content, the total nitrogen, the pH, and the amount of carotinoid pigments in silages from the east and west Sheep Farm Silos. These data are given in Table 7 and 8.

The drymatter, pH and quantities of carotinoids and the β-carotene fraction are significantly different in these silages, but not the total nitrogen. The lack of acid in the fermentation of the much-wilted material does not seem to have greatly affected its acceptability. Although the carotinoid pigments are lower in the silage from the wilted than from freshly cut crops, they are higher on the per-pound basis of the material as fed.

DISCUSSION

These three feeding trials were successful in that along with the standard silages all sheep but the Shropshire ate all the high-drymatter silages fed to them. Table 9 brings together the number of sheep for each trial, the number of feeding days, and the amount of material used.

Compared with all the feeding days for a large flock for a long time, the number of feeding days is not great, but the 19,087 feeding days are certainly enough to give some dependable indications.

The 15 tons of standard silages together with the 12 tons of experimental silages provided sufficient amount and variety on which to base an opinion of the usefulness of silages from much wilted crops.

Total Amounts Eaten and Drymatter Intake

The sum of "totals" in rows D and G, 54091 pounds is the amount actually fed in all tests instead of the 61621 pounds of standard silage that would have been fed to these animals had they been kept on standard silages. The total drymatter that would have been fed in a full use of standard silages is twice the total in row E, or 16,303 pounds, whereas the total drymatter in all feedings is the sum of rows E and F, or 20,762 pounds of drymatter. This is 1.27 times the drymatter in the doubled half-ration of standard silages, a difference of 4,459 pounds.

There is not yet enough evidence to show that sheep will eat these high-drymatter silages continuously over long periods, but consideration of the qualities of the wilted silages justifies careful attention to the advantages of some wilting, or even a great deal. In wilting to 54.4 percent drymatter from the 22 percent drymatter common in standing crops, the 3.545 tons of water in enough standing crop to contain one ton of drymatter, decreased during the wilting to 0.838 tons of water. In this wilting there has been a loss of 76.3 percent of the water, yet there was still enough for the crop to settle and good silage to form. At the time of ensiling the total weight of the crop was down to 40.2 percent of the original crop weight, assuming no loss of drymatter during the drying.

Silage at 22 percent drymatter will probably leak juice until its drymatter content rises to about 26 percent. This seemingly small change of 4 percent in drymatter content represents a 20-percent decrease in water content, and a 15-percent decrease in total weight of silo contents. The normal ensiling and spoilage losses in the silo are in addition to this loss of mass by drainage.

Wilting does not necessarily decrease spoilage losses, but it does reduce the avoidable drainage losses that result from separation of the crop and its juices. The juice carries away much of the water-soluble materials in which are the most available energy-bearing nutrients. The factors of quality which help to make silage, like pasture, a highly productive feed for animals, are also water-soluble.

Treatments with crop conditioners when ensiled, as described by Rogers et al. (7), helps to increase the acceptability of unwilted meadow crops, but wilting reduces both the effectiveness of the treatments and the need for them. Some conditioners reduce juice loss; some may aggravate it.

Crops made into hay will respire in the mow until the moisture loss makes respiration impossible, or until the materials for respiration are used up. Ensiling will stop these respirations quickly because the crop piled into the silo uses up the remaining air in a short time, and no more gets in if the silo is properly sealed. Silage fermentation, which is less destructive than respiration in air, changes the flavor of the ensiled crop. Ensiled, much-wilted crops usually have less flavor than do those made at a high moisture content. With progressing wilting, the flavors tend toward those of the air cured crops.

Carotinoids in the Wilted and Unwilted Silages

On the dry basis, the ratios of the carotinoid content of the unwilted to the wilted silage is 5:4 (Table 7). The 150 lb. of ground earcorn per ton of unwilted crop contributed up to 8 percent of the carotinoids in that silage. Amounts of β-carotene in the unwilted and the wilted silages are in the ratio of 7:6. The wilting and ensiling treatments of the crops seem to have less effect on β-carotene than on the other carotinoids.

Conversely, on the "as-fed" basis, identical weights of wilted and unwilted silage contain carotinoids in the ratio of 5:4, despite the addition of some in the ground earcorn (Table 8). On this same basis the β-carotene in these silages is in the ratio of 4:3.

TABLE 7.—Drymatter, Total Nitrogen, pH and Carotinoids in the 1949 Silages

Sheep farm silo	Drymatter percentage	Total nitrogen (dry basis)	pH*	Carotinoids* on Dry Basis	
				Carotinoids	β-carotene
		%		ppm	ppm
West	34.1	2.02	4.15	166.9	114.7
East	54.4	2.10	5.38	134.8	98.1

*Determinations by R. G. Washburn, Department of Dairy Science.

Hayden et al. (6) recorded the carotinoid contents of 59 silages. None was from as grassy a crop as the 1949 silages at the Sheep Farm. Yet 83 percent of these 59 silages, on the "as-fed" basis, were lower in total carotinoids than was the β-carotene of the 1949 high-drymatter silage at the Sheep Farm, **as it was fed.**

From the data of Hayden et al. (6) converted to the as-fed basis, 35 of the 59 samples were lower in carotinoids than the 1949 standard silage in the west silo at the Sheep Farm. Furthermore, even though the silages were mostly legumes in the earlier Ohio work, 52 of the 59 were lower in carotinoid content than the 1949 much-wilted silage as fed. These placings are on the basis of total carotinoids. The β-carotene content was not determined on the silages reported by Hayden et al.

On the as-fed basis the carotinoids in the Hayden series (6), ranged from 11.4 ppm to 135.0 ppm. The median of the series is at 47.5 ppm, which is still only 83 percent of the β-carotene content on the "as-fed" basis of the 1949 much-wilted silage at the Sheep Farm.

TABLE 8.—Carotinoid Pigments and β-Carotene in Silages from Wilted and Unwilted Crops

Sheep farm silo	Drymatter in the silages	Carotinoid pigments and β-carotene			
		Carotinoid		β-carotene	
		dry basis	as fed	dry basis	as fed
	%	ppm	ppm	ppm	ppm
East	54.4	134.8	71.4	98.1	53.4
West	34.1	166.9	56.9	114.7	39.2
Ratio, East:West, 'as fed'	1.25:1			1.36:1	

When these 59 carotinoid pigment contents were compared to the β-carotene of the 1949 experimental silages on the "as-fed" basis, 21 of the 59 were still below the β-carotene level of the 1949 standard silage, and 35 of these same 59 were below the β-carotene level of the much-wilted 1949 silage fed to sheep.

General Qualities of Silages

Qualities of the 1949 silages on the basis of carotinoid pigments or β-carotene on the as-fed basis compare well with those rated good by Hayden, et al. Four of the five silages above 80 ppm, carotinoids on the as-fed basis were scored "good", and the fifth was "fair". On the as-fed basis the "excellent" silages in the earlier report were lower in β-carotene than the 1949 wilted silage.

In the earlier Ohio series there is a tendency to rate the higher-drymatter silages better than the low. The lowest drymatter of an "excellent" silage is 34.0 percent; the highest drymatter of a "poor" silage is 26 percent. Four of the seven silages lowest in the drymatter are "poor".

This making of silage from much wilted meadow crops and the silage's satisfactory feeding and keeping properties is one more piece of evidence that the range of drymatter in silages made from young crops can vary more widely without serious loss of feeding value and β-carotene, or by spoilage, than can those crops ensiled at a greater age.

Advantages and Real Values of High-Drymatter Silages Need More Study

The possibilities of the very high-drymatter silages are only touched by these experiments. Their development would require much practical use of silages from wilted crops, together with extensive and careful experiments with long-time feeding trials and acceptability tests. Limits of drymatter content for making silage do not seem to exist, as "silages" at 86.6 percent drymatter had a fragrance not associated with hay at same drymatter content stored in a mow.

SUMMARY AND CONCLUSIONS

1. Results of four years of ensiling much-wilted meadow crops have shown the feasibility of making silages containing more than 40 percent drymatter.

2. Although stage of growth and degree of wilting are important to the kind and qualities of silages produced, the "dry" silages that are well preserved from crops of good qualities were willingly eaten after the sheep had consumed a half-ration of standard silage to which they were accustomed.

TABLE 9.—Summary of Weights of Silages, and Drymatter Contents in Rations, as Fed in Three Tests

Row	Item	Silages made in the years: 1946 each day	1946 total	1948 each day	1948 total	1949 each day	1949 total	Totals
A	Number of sheep fed	189	189	372	372	459-457	459	1020
B	Feeding days	189	3780	372	7068	458	8239	19087
		Pounds of silages and drymatter fed						
C	Full ration of silages by feeding plans	567	11340*	1367.5	25983*	1329	24298*	61621*
D	Half-ration of standard silages	283.5	5670	684	12996	average 664.5	12149	30815
E	Drymatter in half-ration of standard silages	69.5	1570	164.3	3122	176.1 and 226.9	3461	8153
F	Drymatter in half-ration of experimental silages	varies	2878	164.3	3122	361.5	6609	12609
G	Half-ration of the experimental silages	283.5	5670	varies	5457	664.5	12149	23276
H	Silages rejected: standard, as fed				81			81
	experimental, as fed		230		40			270
	drymatter in		115		15			130

*Weights of silage that sheep would have been fed, if using standard silages only, for these periods.

3. In some feedings, the drymatter content of the much-wilted silages was more than twice that in the standard silages. These half-rations of high-drymatter silages materially increased the total dry-matter intake by sheep.

4. Sheep accustomed to strongly flavored silages of moderate dry-matter content, ate their half-ration of these silages first, but cleaned up another half-ration of high drymatter silage before the next feeding.

5. Drymatter determinations were made in the silage years when feedings were successful, viz., 1946, 1948, and 1949; only the 1946 silages were scored. Total nitrogen and the pH were normal for the types of 1949 silages produced, and their organoleptic properties seemed to be within the range of normal silages. Compared with high-legume silages of previous years (6), these 1949 silages predominantly of grass, were surprisingly high in the carotinoid pigments.

6. On an as-fed basis, sheep got more β-carotene from the 1949 wilted than from the 1949 standard silage of same material, and on the same as-fed basis, they got more carotinoid pigments per pound of high-drymatter silage than they would have received in 52 of the 59 samples of silages described by Hayden et al. (6). The standard silage for 1949 had more carotinoid pigments on the as-fed basis than 38 of these same 59 samples.

7. The sheep were used only as the indicators of the acceptability of high-drymatter silages to livestock. The test periods were too short to be considered feeding trials for the study of animal responses to the silages. There was no evidence that increased drymatter intake in the silages reduced the appetite for hay. These silages were fed to sheep because sheep provided the most feeding days for the limited amounts of silage available.

8. Although the need for wilting crops to 60 percent drymatter or more for silage may not often arise, this question often comes up: "How much wilting is necessary, is permissible, or is dangerous?" When conditions favor crop wilting, when wilting crops intended for hay are in danger of weather damage, then ensiling such crops with or without treatments becomes the best way to save them.

9. The practice of deliberate wilting, which some farmers use regularly, will probably not become common at any time, especially on hilly or stony land. Many other farmers will not be able or inclined to utilize the advantages of wilting crops for silage. The wilting of young crops is a safe practice, however, when the crops are properly ensiled after wilting, and then fed in such a way that spoilage does not develop.

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