SILAGE AND TRENCH SILOS
IN COLORADO

BY H. B. OSLAND

One of the largest trench silos in Colorado
The Colorado Agricultural College  
FORT COLLINS, COLORADO

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SILAGE AND TRENCH SILOS
IN COLORADO

BY H. B. OSLAND

Trench silos have proved very efficient and at the same time very cheap for the storage of silage. Failures in the storing of silage in trenches have been almost entirely due to improper construction and filling.

Many Colorado feeders who recognize the importance of silage in the ration have dug their own silos with the aid of a plow, a slip and a team. They have found them to be one of the least expensive improvements and yet one of the most necessary on the livestock farm. Silage from trench silos has proved fully as good a feed as silage from upright silos.

**Advantages of Silage.**—1. Silage furnishes excellent succulence.
2. Silage reduces waste in feeding and loss thru weathering.
3. Silage offers a means of saving the immature corn crop.
4. Surplus feed can be carried over from 1 year to another.
5. Silage provides pasture equivalent during the winter.

**Why Feed Silage.**—Silage is a cheap, succulent feed that is well adapted for beef cattle, dairy cattle, sheep and horses at all seasons of the year, but especially during the winter when pastures are not available. It is a very palatable feed and stimulates greater feed consumption and greater production. It tends to keep the digestive system in good condition thru its laxative effects and also aids digestion. Because of these reasons, silage is especially valuable for breeding stock and young growing stock.

**Crops Suitable for Silage in Colorado**

**Corn.**—The corn plant furnishes the most common silage crop. Corn makes a very palatable silage and if it is matured sufficiently and packed well into the silo, the silage will keep for years in good condition.

Corn can be stored in the silo either whole or cut. The latter is preferable altho both practices are successful. More difficulty will unquestionably be experienced in ensiling whole corn than cut corn because of the difficulty of packing the bundles to expel all air even when thoroly tramped and watered. Every air pocket left in the silo
will give mold a chance to grow and cause spoilage in the surrounding area. Another disadvantage of using whole corn is the added labor in handling the silage while feeding. The third factor in favor of cut silage is the greater tonnage which can be stored in the same area. There is, of course, this advantage with whole fodder: It saves the cost of cutting into the silo. Great care must be exercised to lay the bundles parallel to each other, and to cut the bundle strings. These practices aid very much in successfully packing the corn.

The best time to cut corn for silage is when it is nearly mature; that is, when about three-fourths or more of the kernels are hardened so that no milk can be squeezed out.

Immature corn can be used for silage. Perhaps the most outstanding disadvantage of this type of silage is the rather high acidity or sourness which tends to make the silage laxative in its effect. Careful and limited feeding will, however, offset this difficulty. There is of course less dry matter in a given weight of silage from immature corn than from mature corn.

Very dry corn may be siloed just as successfully as green corn if enough water is added to make it pack well in the silo. Every dry cornfodder can be successfully put into the silo if it is cut very fine and enough water added.
Sorghums.—The sorgos such as Amber and Orange cane, and non saccharine sorghums such as kafir, feterita, etc., are suitable for silage. It is very essential, however, that these crops be fully matured before being used for silage. If these crops are harvested earlier, a very sour silage will result which will cause considerable trouble by scouring the stock fed. According to experiments conducted at Kansas and California, there is very little difference in the feeding value between corn and sorghum silage.

Sunflowers.—Where corn does not yield a profitable crop, sunflowers offer a good solution to the silage problem. Experiments at the Colorado Station have shown that the fiber content of sunflowers increases as they ripen. They were found to produce the most palatable and nutritious feed if cut and ensiled when only one-third of the heads are in bloom. This earlier harvesting also avoided considerable resinous taste in the silage. The Colorado experiments showed that sunflower silage compares very favorably with corn silage in feed value, taking the cost of production into consideration. The West Virginia Station reports sunflowers about equal to corn silage for dairy cattle. There are other stations, however, that maintain sunflowers to be inferior to corn for silage. Much of that difference in opinion is probably due to methods used in ensiling the sunflowers. Experiments indicate, however, that sunflower silage is not as palatable as corn silage in the ration when large amounts are fed.

Potatoes.—Quite often potatoes are of low market value with little or no sale for culls and at such times they make a very suitable crop for the silo.

A mixture by weight of 18 percent dry cornfodder and 82 percent cull potatoes was cut into the silo at the Colorado Station during the spring of 1929. The cornfodder was added to insure fermentation and to give the potato silage a moisture consistency similar to that of corn silage. Cutting potatoes alone into the silo gives a product which is extremely difficult to handle at feeding time. The potato-fodder silage showed very little waste and proved to be a very palatable feed. The good storing qualities of this feed were demonstrated by feeding one-half of the silage during the winter of 1929-30 and the other half during the winter of 1930-31.

Miscellaneous Crops.—Beet tops, thistles, sudan grass, etc., are also very well suited for silage but are not discussed in this bulletin because of the relatively small amount of silage from these crops in use at the present time.

Losses of Dry Matter in Ensiling and Field Curing

The Colorado Experiment Station found that an average of 35 percent dry matter was lost when fodder was cured in large shocks
in the field; 43 percent was lost with small shocks standing in the field and 55 percent was lost when the corn was left on the ground. With silage, much of this loss is saved because of the complete utilization of leaves and stalks in making silage.

**Silage for Dairy Cattle**

Dairy farmers especially have appreciated the value of silage. One of the most striking experiments testing the value of silage was made at the Ohio Station. Dairy cows receiving a dry roughage ration of hay and stover with 13.5 pounds of grain were compared with cows being fed 58 pounds silage, a little mixed hay and 4 pounds of grain. The silage-fed cows gave 15 percent more milk at 41 percent less cost.

Silage is not intended to be a complete feed and should always be fed with some dry roughage, and with a well-balanced grain ration. Dairy cows fed heavily on silage without the proper amount of dry roughage and grain may give a good yield of milk for a while but at the end of a few months they are thin and have no reserve to continue.

California, comparing sweet-sorghum silage with Indian-corn silage, reports that only insignificant differences in the effect of the
two silage rations on the production of dairy cows were observed. The results as to amounts of feed eaten and of milk and milk components produced, as well as the average body weight of the cows while on the two kinds of feed, were as nearly similar as might be expected if the cows had been fed the same ration throughout the experiment. Sweet-sorghum silage had a similar or slightly higher feeding value than Indian-corn silage.

Pasture season is universally known as "cheap production season." If milk is produced so cheaply on pasture, why not imitate this summer-pasture condition and provide it in the winter time by preserving a few acres of corn or some other suitable crop in a silo?

The most rapid development in the dairy industry in this state during the past decade has been in the non-irrigated districts of Eastern Colorado, according to the 1930 Colorado Yearbook.

That section of the state produces an abundance of cheap roughages suitable for silage, which is the cheapest succulent feed available to dairymen. It will prove especially valuable on non-irrigated farms of Eastern Colorado, where fresh, green roughages are not very abundant. Silage is not only succulent, it is also very palatable and stimulates greater consumption of hay and other dry roughages. The result is that the cows have more nutrients available for the production of milk.

Experiments show that succulent feeds are even more important in the feeding of dairy cows than other farm animals and that succulent feeds are essential to the economical production of milk. Henry and Morrison, in summarizing tests conducted at different experiment stations, find that 7.4 pounds more milk are produced from 100 pounds of dry matter in the silage rations than in the rations containing corn fodder. The higher value of the silage is not due to any increased digestibility of the silage over well-cured dry fodder but is largely due to the more complete consumption of the silage and the consumption of a heavier ration stimulated by the succulence and palatability of the silage.

Corn silage or sorghum silage is available to every Eastern Colorado farmer. The cost of digging a trench silo does not require a cash outlay. Roughages suitable for silage can be grown much cheaper in Eastern Colorado than in any other section of the state. The trench silo insures feed under all weather conditions, reduces the amount of labor to a great extent during the winter months, keeps the cows in better physical condition, increases milk production and decreases the cost of production.
Silage for Fattening Cattle

Three feeding experiments at the Colorado Station, comparing corn silage and ground cornfodder, show quite comparable results. The first test, carried out under ideal weather conditions, showed $1.03 greater profit per head for the steers fed fodder. The next test, carried on thru a stormy and cold fall and winter, showed a profit of $2.06 per head for silage-fed cattle against a 62 cent return per head for cattle fed fodder. The last test, during which the weather was good and mild, showed $2.07 greater profits per head for the cattle fed silage.

These results seem to indicate that there is little difference in the actual fattening value of silage and cut dried fodder on a dry-matter basis, but the real value of silage is brought out during bad, stormy weather when the silo facilities form such a valuable addition to the fattening operation by furnishing a ready supply of feed.

Table 1.—Corn Silage and Sunflower Silage for Fattening Yearling Steers, 10 Steers per Lot Fed 186 Days at Colorado Experiment Station. (Table Based on One Average Steer)

<table>
<thead>
<tr>
<th>Lot Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ration Fed</td>
<td>Barley</td>
<td>Barley</td>
<td>Barley</td>
</tr>
<tr>
<td>Salt Self-Fed in All Lots</td>
<td>Alfalfa</td>
<td>Sunflower Silage</td>
<td>Corn</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>Sunflower</td>
<td>Silage</td>
<td>Silage</td>
</tr>
<tr>
<td>Weight at Start</td>
<td>757.5</td>
<td>759.8</td>
<td>756.8</td>
</tr>
<tr>
<td>Final Weight at Market</td>
<td>1085.0</td>
<td>1125.5</td>
<td>1135.5</td>
</tr>
<tr>
<td>Gain at Market</td>
<td>330.5</td>
<td>365.7</td>
<td>378.2</td>
</tr>
<tr>
<td>Daily Gain at Market</td>
<td>1.78</td>
<td>2.03</td>
<td>2.03</td>
</tr>
<tr>
<td>Shipping Shrinkage (percent)</td>
<td>3.82</td>
<td>3.90</td>
<td>3.93</td>
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<tr>
<td>Daily Feed Fed:</td>
<td>Ground Barley</td>
<td>11.64</td>
<td>12.12</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>18.17</td>
<td>Sunflower Silage</td>
<td>17.94</td>
</tr>
<tr>
<td>Alfalfa Hay</td>
<td>15.32</td>
<td>10.86</td>
<td>8.09</td>
</tr>
<tr>
<td>Feed Required per cwt. Market Gain:</td>
<td>Ground Barley</td>
<td>653.2</td>
<td>597.9</td>
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<tr>
<td>Corn Silage</td>
<td>835.4</td>
<td>Sunflower Silage</td>
<td>885.0</td>
</tr>
<tr>
<td>Alfalfa Hay</td>
<td>859.8</td>
<td>535.8</td>
<td>367.9</td>
</tr>
<tr>
<td>Feed Cost per cwt. Market Gain</td>
<td>13.75</td>
<td>12.94</td>
<td>12.75</td>
</tr>
</tbody>
</table>

Feed Costs Used:
- Ground Barley $25.00 per ton.
- Corn Silage $6.50 per ton.
- Sunflower Silage $4.50 per ton.
- Alfalfa Hay $13.00 per ton.
The figures quoted above are based on silage from the upright type of silo where production costs are considerably higher than those of the trench silo.

**Discussion of Table 1.**—This experiment shows that the addition of silage to a grain-and-hay ration not only increased the gain produced, but it also decreased the feed cost per 100 pounds gain. Each ton of corn silage fed replaced 183.2 pounds of barley and 1060.9 pounds of alfalfa, or, with the above prices of feeds, each ton of corn silage was worth $9.19 per ton. Sunflower silage replaced 117.1 pounds of barley and 711.6 pounds of alfalfa for each ton of silage fed, or was worth $6.09 per ton in this experiment.

**Table 2.—Corn Silage and Potato-Cornfodder Silage for Fattening Calves, 10 Steers per Lot Fed 155 Days at Colorado Experiment Station. 2-Year Average.**

*(Table Based on One Average Calf)*

<table>
<thead>
<tr>
<th>Lot Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ration Fed</td>
<td>Barley</td>
<td>Barley</td>
<td>Barley</td>
</tr>
<tr>
<td>C. S. Cake</td>
<td>Potato-Cornfodder</td>
<td>C. S. Cake</td>
<td>C. S. Cake</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>Silage</td>
<td>Alfalfa</td>
<td>Alfalfa</td>
</tr>
<tr>
<td>Minerals and Salt Self-Fed in All Lots.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight at Start</td>
<td>423.2</td>
<td>418.1</td>
<td>417.2</td>
</tr>
<tr>
<td>Final Weight at Market</td>
<td>737.7</td>
<td>738.3</td>
<td>770.8</td>
</tr>
<tr>
<td>Gain at Market</td>
<td>394.0</td>
<td>302.2</td>
<td>333.6</td>
</tr>
<tr>
<td>Daily Gain at Market</td>
<td>1.88</td>
<td>1.86</td>
<td>1.82</td>
</tr>
<tr>
<td>Shipping Shrinkage (percent)</td>
<td>3.75</td>
<td>3.24</td>
<td>3.94</td>
</tr>
</tbody>
</table>

**Daily Feed Fed:**
- Ground Barley: 6.69
- Corn Silage: 13.50
- Potato-Cornfodder Silage: 15.56
- C. S. Cake: 0.99
- Alfalfa Hay: 10.06
- Mineral Mixture: 0.02
- Salt: 0.03

**Feed Required per cwt. Market Gain:**
- Ground Barley: 325.4
- Corn Silage: 234.4
- Potato-Cornfodder Silage: 247.5
- C. S. Cake: 840.3
- Alfalfa Hay: 325.4
- Mineral Mixture: 540.3
- Salt: 298.2
- Market Gain: 233.7

**Feed Cost per cwt. Market Gain:**
- 8.47
- 8.43
- 8.15

**Feed Costs Used:**
- Ground Barley: $24.00 per Ton
- Corn Silage: 6.00 per Ton
- Potato-Cornfodder Silage: 6.09 per Ton
- Cottonseed Cake: $44.48 per Ton
- Alfalfa Hay: 11.25 per Ton
- Mineral Mixture: 26.15 per Ton
- Salt: 10.50 per Ton
Both of the lots fed silage outsold the straight grain-and-hay lot on the market because of the finish they carried. Lot No. 2, the sunflower-silage lot, brought 37 cents more per cwt. and lot No. 3, the corn-silage lot, outsold lot No. 1 45 cents per cwt.

This test also shows that sunflower silage, with a production cost of 69.23 percent that of corn silage, was worth 66.27 percent as much as corn silage, and furthermore indicates that sunflowers offer a good substitute for corn where climatic conditions favor a materially heavier yield of sunflowers than corn.

**Discussion of Table 2.**—The addition of silage to a grain-cake-and-hay ration for fattening calves did not increase the gains but slightly decreased the cost of producing unit gains, and checked digestive troubles and bloats with the calves.

Both corn and potato silage, but especially corn silage, greatly increased the palatability of the ration and produced smoother, nicer-coated animals than the grain-cake-and-hay ration.

The valuation placed on these cattle was $9.15 per cwt. on the corn-silage-fed calves; $8.80 per cwt. on the potato-cornfodder-silage-fed calves, and $8.70 per cwt. on the grain-cake-and-hay calves.

Each ton of corn silage fed in these tests replaced 181.29 pounds of barley, 816.85 pounds of alfalfa hay and 1.16 pounds of salt but required 3.49 pounds more of cake and 1.40 pounds minerals. With feed prices used, each ton of silage was worth $6.72.

**Table 3.**—Corn Silage vs. Kafir Silage vs. Atlas Silage* for Steers and Heifers Mixed. Fed 150 days at Kansas Agricultural Experiment Station.

<table>
<thead>
<tr>
<th>Lot Number</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Animals per Lot</td>
<td>10</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td><strong>Ration Fed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kafir Silage</td>
<td>Atlas Silage</td>
<td>Corn Silage</td>
<td></td>
</tr>
<tr>
<td>C.S. Cake</td>
<td>C.S. Cake</td>
<td>C.S. Cake</td>
<td></td>
</tr>
<tr>
<td><strong>Weight at Start</strong></td>
<td>421.10</td>
<td>428.67</td>
<td>430.29</td>
</tr>
<tr>
<td><strong>Final Weight</strong></td>
<td>584.90</td>
<td>587.56</td>
<td>597.14</td>
</tr>
<tr>
<td><strong>Average Gain</strong></td>
<td>163.80</td>
<td>162.89</td>
<td>168.85</td>
</tr>
<tr>
<td><strong>Average Daily Gain</strong></td>
<td>1.05</td>
<td>1.07</td>
<td>1.10</td>
</tr>
<tr>
<td><strong>Average Daily Ration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kafir Silage</td>
<td>33.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlas Silage</td>
<td></td>
<td>34.19</td>
<td></td>
</tr>
<tr>
<td>Corn Silage</td>
<td></td>
<td>34.19</td>
<td></td>
</tr>
<tr>
<td>Cottonseed Cake</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Average Gain per Ton Fed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kafir Silage</td>
<td>64.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlas Silage</td>
<td></td>
<td>62.60</td>
<td></td>
</tr>
<tr>
<td>Corn Silage</td>
<td></td>
<td></td>
<td>64.34</td>
</tr>
</tbody>
</table>
Potato-corn fodder silage replaced 195.17 pounds of barley, 681.90 pounds of alfalfa hay and 1.67 pounds of salt less 1.19 pounds of cake and .71 pound of minerals, or, each ton of potato-corn fodder silage was worth $6.20.

Silage for Wintering Cattle

Cheap, bulky, carbonaceous roughages, supplemented with a protein-rich feed, form the foundation of a successful winter ration and silage is, without doubt, one of the outstanding roughages for that purpose because of the succulence which it furnishes along with the bulk.

Table 4.—Corn Silage vs. Ground Cornfodder for Steers and Heifers Mixed. Fed 150 days at Kansas Agricultural Experiment Station.

| Lot Number |  |  
|------------|---|---
| 7          | 8 |
| Number of Animals per Lot | 7 | 9 |
| Ration Fed | Corn Silage | C. S. Cake | Gr. Cornfodder | C. S. Cake |
| Weight at Start | 430.90 | 422.00 |
| Final Weight | 697.14 | 588.67 |
| Total Gain | 166.25 | 161.67 |
| Average Daily Gain | 1.10 | 1.07 |
| Average Daily Ration | Corn Silage | 34.19 | Corn Silage | 17.25 |
| | Ground Cornfodder | 1.00 | Ground Cornfodder | 1.00 |
| Average Gain per Ton Fed | Corn Silage | 64.34 | 124.06 |
| | Ground Cornfodder | |
| Average Gain per Acre Fed | Corn Silage | 368.02 | 225.79 |
| | Ground Cornfodder | |

*Atlas silage is made from Atlas sorgo, a very high-yielding variety of the sweet sorghums.

Discussion of Tables 3 and 4.—Kansas results shown in Table 3 clearly indicate that the various types of silage can be utilized to good advantage in carrying steers thru the winter. It is very interesting to note the almost identical daily gains produced by each ton of the different kinds of silage. Furthermore, the gain produced for each ton of silage fed is almost the same. This experiment demonstrates that sorghum silage can be utilized to good advantage and that sorghums make desirable silage if they are allowed to mature be-
fore they are cut into the silo. Common belief is that silage from
the sorghums makes an extremely sour silage which is not fit to be
used as a feed for cattle. The latter is quite true if the sorghums
are immature at the time of cutting.

Table 4 gives a comparison of cornfodder with corn silage and
proves quite conclusively the advantage of silage over the ground
cornfodder in a wintering ration. Corn silage produced 368.02
pounds more gain for every acre fed; whereas each acre of corn-
fodder gave only 225.79 pounds gain, or a difference of 142.23 pounds
in favor of the calves fed silage for each acre fed to the cattle.

Silage for Fattening Lambs

Silage is perhaps less essential in the lamb-fattening ration than
in any other ration for livestock. When silage is fed as the only
roughage with a grain-and-cake ration, the lambs will gain very slow-
ly and will not be finished for market when they reach a weight of
90 to 95 pounds.

<table>
<thead>
<tr>
<th>Lot Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ration Fed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shelled Corn</td>
<td>Shelled Corn</td>
<td>Shelled Corn</td>
</tr>
<tr>
<td></td>
<td>Alfalfa</td>
<td>Corn Silage</td>
<td>Sunflower Silage</td>
</tr>
<tr>
<td>Salt Solf Fed in All Lots</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight at Start</td>
<td>52.0</td>
<td>51.4</td>
<td>52.9</td>
</tr>
<tr>
<td>Final Weight at Market</td>
<td>85.1</td>
<td>85.7</td>
<td>88.6</td>
</tr>
<tr>
<td>Gain at Market</td>
<td>33.1</td>
<td>34.3</td>
<td>35.7</td>
</tr>
<tr>
<td>Daily Gain at Market</td>
<td>.33</td>
<td>.34</td>
<td>.36</td>
</tr>
<tr>
<td>Shipping Shrinkage (Percent)</td>
<td>3.76</td>
<td>5.29</td>
<td>5.29</td>
</tr>
</tbody>
</table>

Daily Feed Fed:
- Shelled Corn
  - .98
- Corn Silage
  - 1.13
- Sunflower Silage
  - .98
- Alfalfa Hay
  - 1.86

Feed Required per cwt.
- Market Gain:
  - Shelled Corn
    - 302.6
  - Corn Silage
    - 286.7
  - Sunflower Silage
    - 329.0
  - Alfalfa Hay
    - 316.2

Feed Cost per cwt.
- Market Gain
  - 8.05
  - 8.15
  - 7.99

Feed Costs Used:
- Shelled Corn $30.00 per Ton
- Sunflower Silage $4.50 per Ton
- Corn Silage $6.00 per Ton
- Alfalfa Hay $12.00 per Ton
Discussion of Table 5.—Corn silage or sunflower silage can be used in limited amounts for lambs. It is true that they will not influence the rate or cost of gain very materially but they do lessen the amount of alfalfa or other roughage required to produce unit gains. The higher the cost of these roughages, the more profitable the addition of silage to the ration. Perhaps the biggest objection to silage, according to Colorado results, is that it tends to produce more growth than finish.

Each ton of corn silage fed in this test replaced 96.4 pounds of shelled corn and 660 pounds of alfalfa, showing a feed replacement value of $5.41 per ton.

Sunflower silage showed a replacement value of $4.92 per ton with prices of feeds given in Table 5.

Sunflower silage in a fattening ration for lambs was worth 90.9 percent the value of corn silage with corn at $30.00 per ton and alfalfa hay $12.00 per ton.

Silage for Breeding Ewes

Corn silage has proved a very valuable feed for breeding ewes in farm flocks. Early Colorado work and also several of the eastern experiment stations have shown the value of silage for pregnant ewes. Silage not only cheapened the winter ration, but also produced slightly larger lambs. Experiences of range sheepmen, however, have not been favorable toward the use of silage. Silage fed during the winter produced an ample supply of milk but the scanty, green, "washed" grasses during the early spring reduced the milk flow quite sharply and the ewes did not produce a sufficient amount for the lambs.

Every possible precaution must be exercised that the silage fed to the ewes in the farm flock is free from mold and spoiled particles. Several Colorado breeders have had some death losses thru feeding moldy silage. These losses have been very small, however, and need not be very alarming to the breeder of sheep as long as he is careful as to the quality of silage which he feeds.

Spoiled Silage

Spoiled silage is usually due to three factors: 1. Failure to pack the fodder properly, thereby allowing air pockets to remain in the silage. 2. Putting dry fodder in the silo without using enough water to help in packing the silage and expelling the air. 3. Leaky walls or doors which give the air access to the silage. Wherever air contacts the silage, molds will form and spoil the surrounding silage.

Spoiled or frozen silage should never be fed to livestock because of the great danger of death loss with all classes of stock.
Construction of the Trench Silo

A trench silo is a rather simple structure. It is nothing more nor less than a large ditch in the ground with sloping ends for convenience and ease during construction, during filling and when removing the silage. If the ends are left with a gradual slope, a wagon can easily be driven thru at filling time or backed down for loading with silage, thus greatly reducing the amount of labor. See page 15.

The trench silo should be located in a place having good drainage to avoid its filling up with water during the wet season. An excess of moisture is very likely to cause the silage to become sour.

A plow, a slip or fresno, a spade, a team and the farmer's labor constitute the construction cost of a trench silo. The silo can usually be made when this labor and equipment are not needed for other work.

It is always a good plan to make the silo somewhat narrower than desired so that the sides can be smoothed-up each year without getting the silo excessively wide. The soil will gradually cave away from the walls due to weather and moisture conditions.

The size of the trench silo depends entirely on the number and kind of stock to be fed. Tables 6 and 7 give the average silage consumption of various kinds of livestock and the method for calculat-

In light, sandy soil, concrete or stone walls are essential. The wood wall shown on the right side of the picture did not compare favorably with the concrete forming the left wall.
ing capacity in the silo. With the aid of these two tables, each farmer can figure the size of silo needed for his operation.

Longitudinal section showing both ends of silo sloping to allow team and wagon to drive thru at silo filling time.

If the silo is to be used as a permanent structure, one may install permanent walls such as illustrated on page 14. Either stone or cement make excellent material for silo walls. A concrete mixture of 1 part cement, 2 parts sand and 4 parts gravel, not over three-fourths inch in size, is recommended for cement walls. The walls of a trench silo should be slightly sloping to lessen caving-in of dirt walls, to give stability to permanent walls of rock or cement, and because they aid materially in the ease of packing the silage.

A concrete wall 3 to 4 inches thick, and including hog wire or light steel bars for reinforcement, will cost about 7 cents per square foot. For a silo 56 feet long with two 20-foot sloping ends, it will cost approximately $60.00. For a rock wall with one-half-inch plastered surface, the cash cost for cement would be about $25.00. These estimates are based on cement at 80 cents per sack. Another suggestion is to build a concrete wall using the rock as a filler in the walls. This would eliminate all the fitting of the rock into layers and reduce considerably the quantity of cement necessary.

Cross section of trench silo showing permanent sides constructed of stone or cement. These types of walls are very desirable for permanence and in sandy, loose soils where caving in of the walls is excessive.
Where the soil is well drained there is no advantage in a concrete floor in the trench silo. If the bottom is inclined to become muddy, causing loss of silage and difficulty in getting wagons or feed carts in and out, a 4-inch concrete floor will be a valuable addition to the silo. A concrete floor also tends to strengthen the walls, both stone and concrete, in keeping them from sliding or buckling, which sometimes happens when the soil around the walls gets excessively wet.

The width and depth of the trench silo varies with different farms according to the number of animals to be fed. The silo must be small enough so that at least a foot of silage is removed in 4 to 5 days to prevent spoilage. The average width of the silo times the depth gives the square feet of feeding surface. An average cubic foot of silage will weigh between 30 and 35 pounds. The number of cattle or sheep to be fed, times the average daily feed, will give the amount of silage in pounds which will be removed daily from the trench. Average width and depth dimensions which generally are used are given in the illustration as shown below.

The length of the silo is optional as long as it holds sufficient silage to carry a certain number of stock thru the feeding period. The silo can be made long enough to carry silage for two seasons because the trench silo preserves silage fully as well as an upright silo if it is packed properly.
A trench silo where ground water stands high.

Where weather conditions are such that snow is likely to drift into the emptied portion of the silo, it may be advisable to cover the trench after filling. Woven wire, stapled on poles which are resting on the sides of the silo, and covered with straw, makes an ideal and at the same time cheap roof for the silo. See illustration, page 16. Portable A-shaped roofs built in small sections can be used to good advantage. When this type of roof is used, it is customary to build a low concrete or plank curb around the silo.

The depth of the silo times the average width times the length gives the capacity of the silo, which will be in cubic feet if all dimensions are in feet. The cubic feet divided by 60 equals the number of tons in the silo.

Table 6.—Average Silage Consumption of Livestock

<table>
<thead>
<tr>
<th>Category</th>
<th>Average Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Breeding Cows</td>
<td>30 to 50 Pounds</td>
</tr>
<tr>
<td>Fattening Cattle:</td>
<td></td>
</tr>
<tr>
<td>2-Year Old Steers</td>
<td>30 to 40 Pounds</td>
</tr>
<tr>
<td>Yearling Steers</td>
<td>20 to 30 Pounds</td>
</tr>
<tr>
<td>Calves</td>
<td>15 to 20 Pounds</td>
</tr>
<tr>
<td>Dairy Cows, in Milk</td>
<td>30 to 50 Pounds</td>
</tr>
<tr>
<td>Dry Cows</td>
<td>20 to 35 Pounds</td>
</tr>
<tr>
<td>Dairy Heifers</td>
<td>12 to 20 Pounds</td>
</tr>
<tr>
<td>Fattening Lambs</td>
<td>1 to 3 Pounds</td>
</tr>
<tr>
<td>Breeding Ewes</td>
<td>2 Pounds</td>
</tr>
<tr>
<td>Idle Horses</td>
<td>10 to 15 Pounds</td>
</tr>
</tbody>
</table>

Table 7.—Figuring Capacity of the Trench Silo

Depth (in feet) X Average Width (in feet) X Length (in feet) = Cubic Feet (capacity)

\[
\text{Cubic Feet} = \text{Number of tons in silo}
\]

60
For example, a silo 8 feet deep which is 12 feet wide on top and 8 feet wide at the bottom, (an average of 10 feet) and 40 feet long, will hold 3200 cubic feet, 3200 cubic feet divided by 60 gives 53.3 tons. In other words, this silo has a capacity for 53.3 tons of silage. This is however, only a rough estimate because the weight of the silage varies with the moisture it contains.

Filling the Silo

The silage cutter can be set up either in or at the side of the trench silo, or wagons can haul the cut silage from the cutter, or if a combination harvester and cutter is used, wagons haul the cut silage directly from the field. Filling the trench with team and wagon greatly helps in packing the silage when the wagons are driven thru the trench for unloading. Tractors driven back and forth as the silo is being filled have proved to be one of the best ways for packing and settling the silage. The packing and watering of silage at the time of filling can hardly be over-emphasized because the success of making silage depends more on these two factors than on everything else combined. Be sure that the silage is packed well! The silo should be filled about 2 or 3 feet above the top to insure a full silo when the silage has settled.

Water should be added to the silage whether cut or uncut, dry or green. The silage along the sides of the silo should be very heavily
soaked as the surrounding dry soil soon dries up and absorbs the water. It is the opinion of most experienced users of silage from trench silos that too much water cannot be added. There is much more likelihood of moldy silage caused by lack of water than of sour silage caused by too much water. Any excessive moisture is readily absorbed by the walls and floor and assists in keeping the silage in good moist condition over a longer period of time. All trench silos should be constructed in a location where water is readily available.

The best method of sealing the trench silo is a much discussed one. Some farmers use 6 inches of chaffy wet straw, others use straw covered with soil and still others use only about a 6-inch layer of wet soil. Without doubt, the latter method has proved the most successful. Straw alone usually allows enough air to penetrate to spoil the top layer of silage. Straw covered with soil allows air to remain in the straw which in turn allows spoilage of the top layer. Soil alone excludes all air and consequently there is no chance for spoilage. Most of the labor of covering can be done with a scraper by starting at the ends and working in a little with each load. It is true that there will be a little waste of silage at the time of feeding but with ordinary care this layer of soil can be removed without wasting much
A shallow trench silo very adequate where ground water stands high. Notice the high soil walls

silage. The soil can be thrown on the bank of the silo for use the following season and also to prevent surface water from running into the silo.

If the silage is to be used the following winter, 5 or 6 inches of earth are sufficient for covering; but if it is to be carried over for late spring, summer, or the following winter, it is best to use at least 10 to 12 inches. If the soil is dry, it should be wet and well tamped, and this is best repeated after 4 days, and again at the expiration of 10 to 12 days. This eliminates all air pockets and leaves the silage in shape to make excellent feed and keep in good condition for a long time.

Removing Silage

When one is ready to begin feeding silage, the soil should be stripped back from the most convenient end, uncovering only a small portion at a time. The soil can be placed in the empty portion of the silo or on the sides. Where the corn has been uncut, a hay knife should be used for removing it. It has been stated by people who have used the trench silo, that one can feed in half to two-thirds the time required to feed from the pit or overhead type.
Cost of Filling Trench Silos

On many farms this will be a family job with no cash paid out for hired help. One farmer reports that two men cut the feed with a header and forked it from the barges into the silo. Twelve loads were put in per day for 8 days, making 70 tons of silage. Not one cent was paid out for help and the most simple machinery, already on hand, was used. Fifty head of cattle were turned into the silo twice a day to tramp the silage. Another farmer reports he hired 6 men, 2 teams and wagons for 5 days to help fill his silo. Putting this silage up cost him $75.00 for 147 tons or 51 cents per ton. A farmer in El Paso County, reports his cash outlay for filling his silo was around 40 cents per ton. The latter figure is without doubt below the average but the important point is that the average cost for filling a trench silo is comparatively low and within the reach of most livestock farmers.

References

1. Circular 76, North Dakota.
2. Farmers Bulletin No. 578, U. S. D. A.
3. California Agricultural Experiment Station Bulletin No. 282.
5. Extension Circular No. 713, Nebraska.
11. Extension Circular 264, South Dakota.
12. Extension Circular No. 75, New Mexico.
15. Extension Circular No. 8, Colorado.
17. Ohio Experiment Station Results.